Dr. Babasaheb Ambedkar Technological University
(Established as University of Technology in the State of Maharashtra)
(Under Maharashtra Act No. XXIX of 2014)
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CURRICULUM

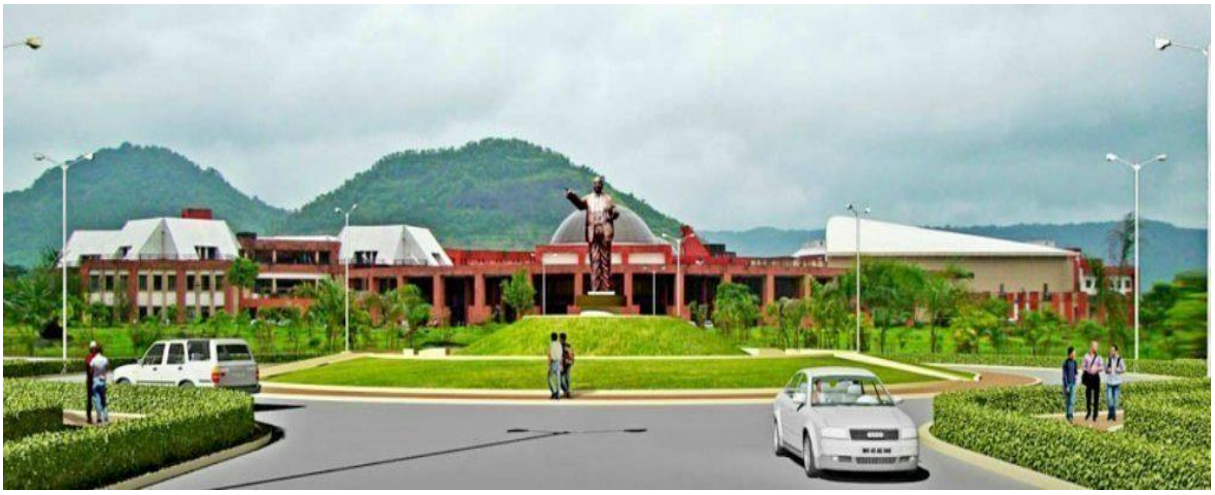
UNDER GRADUATE PROGRAMME

B.TECH

SAFETY AND FIRE ENGINEERING

2nd and 3rd year

ACADEMIC YEAR2023-2024.



Programme Outcome

A graduate in Safety & Fire Engineering will be able to

PO1: Engineering knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.

PO2: Problem analysis: Identity, formulate, research literature, and analyze complex safety and fire related problems reaching substantiated conclusions using the first principles of mathematics, natural sciences, and engineering sciences.

PO3: Design/development of solutions: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for fire safety and disaster management of industry and society, and the cultural, societal, and environmental considerations.

PO4: Conduct investigations of complex problems: Use research-based knowledge and research methods including design of experiments, analysis, and interpretation of data, and synthesis of the information to provide valid conclusions.

PO5: Modern tool usage: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools, including prediction and modelling to complex safety and fire engineering activities, with an understanding of the limitations.

PO6: The engineer and society: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the safety engineering.

PO7: Environment and sustainability: Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development and safety.

PO8: Ethics: Apply ethical principles and commit to professional ethics and responsibilities and norms of the safety and fire engineering practice.

PO9: Individual and teamwork: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.

PO10: Life-long learning: Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

A graduate in Safety & Fire Engineering will be able to:

PSO1: Design a fire safety system for an industry or a building thereby saving the loss due to a fire accident.

PSO2: Analyze hazards in a workplace and rectify it

EVALUATION SYSTEM:

1. Absolute grading system based on absolute marks as indicated below will be implementeds from academic year 2023-24,starting from I year B.Tech.

Perentage of marks	Letter grade	Grade point
91-100	EX	10.0
86-90	AA	9.0
81-85	AB	8.5
76-80	BB	8.0
71-75	BC	7.5
66-70	CC	7.0
61-65	CD	6.5
56-60	DD	6.0
51-55	DE	5.5
40-50	EE	5.0
<40	EF	0.0

2. Class is awdared based on CGPA of all eigth semster of B.Tech Program.

CGPA for pass is minimum 5.0	
CGPAupto<5.50	Pass class
CGPA ≥ 5.50 &<6.00	SecondClass
CGPA ≥ 6.00 &<7.50	First Class
CGPA ≥ 7.50	Distinction
[Percentage of Marks =CGPA*10.0]	

A total of 100 Marks for each theory course are distributed as follows:

	MidSemester Exam (MSE) Marks	20
	ContinuousAssesment Marks	20
	End SemesterExamination(ESE)Marks	60

4.A total of 100 Marks for each practical course are distributed as follows:

1.	Continuous Assesment Marks	60
2.	End Semester Examination (ESE)Marks	40

It is mandatory for every student of B.Tech. to score a minimum of 40 marks out of 100, with a minimum of 20 marks out of 60 marks in End Semester Examination for theory course.

5. Description of Grades:

EX Grade: An 'EX' grade stands for outstanding achievement.
EE Grade: The 'EE' grade stands for minimum passing grade.
The students may appear for the remedial examination for the subjects he/she failed for the current semester of admission only and his/her performance will be awarded with EE grade only.
If any of the student remain Absent for the regular examination due to genuine reason and the same will be verified and tested by the Dean (Academics) or committee constituted by the University Authority.
FF Grade: The 'FF' grade denotes very poor performance, i.e. failure in a course due to poor performance .The students who have been awarded 'FF' grade in a course in any semester must repeat the subject in next semester.

6. Evaluation of Performance:

1. Semester Grade Point Average (SGPA) and Cumulative Grade Point Average (CGPA)

(A) Semester Grade Point Average (SGPA) The performance of a student in a semester is indicated by Semester Grade Point Average (SGPA) which is a weighted average of the grade points obtained in all the courses taken by the student in the semester and scaled to a maximum of 10. (SGPI is to be calculated up to two decimal places). A Semester Grade Point Average (SGPA) will be computed for each semester as follows:

$$SGPA = \frac{[\sum_{i=1}^{n} c_i \, g_i]}{[\sum_{i=1}^{n} c_i]}$$

Where
'n' is the number of subjects for the semester,
'ci' is the number of credits allotted to a particular subject, and
'gi' is the grade-points awarded to the student for the subject based on his performance as
per the above table.
-SGPA will be rounded off to the second place of decimal and recorded as such.

(B) Cumulative Grade Point Average (CGPA): An up to date assessment of the overall performance of a student from the time he entered the Institute is obtained by calculating Cumulative Grade Point Average (CGPA) of a student. The CGPA is weighted average of the grade points obtained in all the courses registered by the student since s/he entered the Institute. CGPA is also calculated at the end of every semester (upto two decimal places).Starting from the first semester at the end of each semester (S), a Cumulative Grade Point Average (CGPA) will be computed as follows:

$$CGPA = \frac{[\sum_{i=1}^{m} c_i g_i]}{[\sum_{i=1}^{m} c_i]}$$

Where
'm' is the total number of subjects from the first semester onwards up to and including the
semester S,
'ci' is the number of credits allotted to a particular subject, and
'gi' is the grade-points awarded to the student for the subject based on his/her performance as per the above table.

-CGPA will be rounded off to the second place of decimal and recorded as such.

Award of Degree of Honours
Major Degree

The concept of Major and Minors at B.Tech level is introduced , to enhance learning skills of students, acquisition of additional knowledge in domains other than the discipline being pursued by the student, to make the students better employable with additional knowledge and encourage students to pursue cross-discipline research.

A. Eligibility Criteria for Majors

1. The Student should have Minimum CGPA of 7.5 up to 4th Semester
2. Student willing to opt for majors has to register at the beginning of 5th Semester
3. The Student has to complete 5 additional advanced courses from the same discipline specified in the curriculum. These five courses should be of 4 credits each amounting to 20 credits. The students should complete these credits before the end of last semester.
4. Student may opt for the courses from NPTEL/ SWAYAM platform. (if the credits of NPTEL/ SWAYAM courses do not match with the existing subject proper scaling will be done)

Student complying with these criteria will be awarded B.Tech (Honours) Degree.

B. Eligibility Criteria for Minors

1. The Student should have Minimum CGPA of 7.5 up to 4th Semester
2. Student willing to opt for minors has to register at the beginning of 5th Semester
3. The Student has to complete 5 additional courses from other discipline of their interest, which are specified in the respective discipline. These five courses should be of 4 credits each amounting to 20 credits.

4. Student may opt for the courses from NPTEL/ SWAYAM platform. (if the credits of NPTEL/ SWAYAM courses do not match with the existing subject proper scaling will be done)

Student complying with these criteria will be awarded with B.Tech Degree in -------Engineering withMinor in --------- Engineering.
(For e.g.: B. Tech in Civil Engineering with Minor in Computer Engineering)

For applying for Honours and Minor Degree the student has to register themselves through the proper system.

ATTENDANCE REQUIREMENTS:

1. All students must attend every lecture, tutorial and practical classes.
2. To account for approved leave of absence (eg. representing the Institute in sports, games or athletics; placement activities; NCC/NSS activities; etc.) and/or any other such contingencies like medical emergencies, etc., the attendance requirement shall be a minimum of 75% of the classes actually conducted.
   If the student failed to maintain 75% attendance, he/she will be detained for appearing the successive examination.
   The Dean (Academics)/ Principal is permitted to give 10% concession for the genuine reasons as such the case may be.
   In any case the student will not be permitted for appearing the examination if the attendance is less than 65%.
3. The course instructor handling a course must finalize the attendance 3 calendar days before the last day of classes in the current semester and communicate clearly to the students by displaying prominently in the department and also in report writing to the head of the department concerned.
4. The attendance records are to be maintained by the course instructor and he shall show it to the student, if and when required.

TRANSFER OF CREDITS

The courses credited elsewhere, in Indian or foreign University/Institutions/ Colleges/Swayam Courses by students during their study period at DBATU may count towards the credit requirements for the award of degree. The guidelines for such transfer of credits are as follows:

a) 20 % of the total credit will be considered for respective calculations.

b) Credits transferred will be considered for overall credits requirements of the programme.

c) Credits transfer can be considered only for the course at same level i.e UG, PG etc.

d) A student must provide all details (original or attested authentic copies)such as course contents, number of contact hours, course instructor /project guide and evaluation system for the course

for which he is requesting a credits transfer. He shall also provide the approval or acceptance letter from the other side. These details will be evaluated by the concerned Board of Studies before giving approval. The Board of Studies will then decide the number of equivalent credits the student will get for such course(s) in DBATU. The complete details will then be forwarded to Dean for approval.

e) A student has to get minimum passing grades/ marks for such courses for which the credits transfers are to be made.

f) Credits transfers availed by a student shall be properly recorded on academic record(s) of the student.

g) In exceptional cases, the students may opt for higher credits than the prescribed.

Abbreviations

BSC: *Basic Science Course*

ESC: *Engineering Science Course*

PCC: *Professional Core Course*

PEC: *Professional Elective Course*

OEC: *Open Elective Course*

HSSMC: *Humanities and Social Science including Management Courses*

PROJ: *Project work, seminar and internship in industry or elsewhere*

Course Structure for Semester III
B. Tech in Safety and Fire Engineering(w.e.f. 2023-24)

Semester III										
Course Category	**Course Code**	**Course Title**	**Teaching Scheme**			**Evaluation Scheme**				**No. of Credits**
			L	**T**	**P**	**CA**	**MSE**	**ESE**	**Total**	
PCC1	BTSFC301	Safety Management	3	-	-	20	20	60	100	3
PCC2	BTSFC302	Fire Engineering Science	3	-	-	20	20	60	100	3
ESC10	BTES303	Mechanical Engineering Drawing	3	-	-	20	20	60	100	3
ESC11	BTES304	Mechanics of Fluids	3	-	-	20	20	60	100	3
HSSMC3	BTHM305	Business Communication Skill	2	-	-	50	-	-	50	2
PCC3	BTSFCL306	Safety Management Lab	-	-	2	60	-	40	100	1
PCC4	BTSFCL307	Fire Engineering Lab	-	-	2	60	-	40	100	1
ESC12	BTESL308	Mechanical Engineering Drawing Lab	-	-	4	60	-	40	100	2
ESC13	BTESL309	Fluid Mechanics Lab	-	-	2	60	-	40	100	1
PROJ-I	BTES209P	Internship 1 Evaluation	-	-	-	-	-	100	100	1
LC1	BTSFD310	Drill- 1	-	-	4	50	-	-	50	2
		Total	**14**	**-**	**14**	**420**	**80**	**500**	**1000**	**22**

BSC = Basic Science Course, ESC = Engineering Science Course, PCC = Professional Core CoursePEC = Professional Elective Course, OEC = Open Elective Course, LC = Laboratory Course HSSMC = Humanities and Social Science including Management Courses

Semester IV										
Course Category	**Course Code**	**Course Title**	**Teaching Scheme**			**Evaluation Scheme**				**No. of Credit**
			L	**T**	**P**	**CA**	**MSE**	**ESE**	**Total**	
PCC5	BTSFC401	Safety in Engineering Industry	3	-	-	20	20	60	100	3
PCC6	BTSFC402	Fire Service Equipment and Appliances	3	-	-	20	20	60	100	3
PEC1	BTSFPE403A-C	Elective-I	4	-	-	20	20	60	100	4
ESC14	BTES404	Thermodynamics and Heat Transfer	3	-	-	20	20	60	100	3
ESC15	BTES405	CAD and Computer Proficiency	2	-	-	50	-	-	50	2
PCC7	BTSFCL406	Safety in Engineering Industry Lab	-	-	2	60	-	40	100	1
PCC8	BTSFCL407	Fire Service Equipment and Appliances Lab	-	-	2	60	-	40	100	1
ESC16	BTESL408	Thermodynamics and Heat Transfer Lab	-	-	2	60	-	40	100	1
ESC17	BTESL409	CAD and Computer Proficiency Lab	-	-	4	60	-	40	100	2
LC-2	BTSFD410	Drill -2	-	-	4	50	-	-	50	2
		Total	**15**	**-**	**14**	**420**	**80**	**400**	**900**	**22**

BSC = Basic Science Course, ESC = Engineering Science Course, PCC = Professional Core Course
PEC = Professional Elective Course, OEC = Open Elective Course, LC = Laboratory Course
HSSMC = Humanities and Social Science including Management Courses

Elective I

Sr No.	Course Code	Course Name
1	BTSFPE403A	Fire Codes and Standards
2	BTSFPE403B	Fire Laws
3	BTSFPE403C	Urban Planning

Semester V										
Course Category	**Course Code**	**Course Title**	**Teaching Scheme**			**Evaluation Scheme**				**No. of Credits**
			L	**T**	**P**	**CA**	**MSE**	**ESE**	**Total**	
PCC9	BTSFC501	Safety in Civil Engineering	3	-	-	20	20	60	100	3
PCC10	BTSFC502	Fire Prevention and Rescue	2	-	-	20	20	60	100	2
PCC11	BTSFC503	Disaster Management	3	-	-	20	20	60	100	3
PEC2	BTSFPE504A-C	Elective-II	3	-	-	20	20	60	100	3
OEC1	BTSFOE505A-C	Open Elective-I	3	-	-	20	20	60	100	3
PCC12	BTSFCL506	Safety in Civil Engineering Lab	-	-	2	60	-	40	100	1
PCC13	BTSFCL507	Fire Prevention and Rescue Lab	-	-	4	60	-	40	100	2
PCC14	BTSFCL509	Disaster Management Lab	-	-	2	60	-	40	100	1
LC3	BTSFD510	Drill- 3	-	-	4	50	-	-	50	2
		Total	**14**	**-**	**16**	**450**	**100**	**500**	**1050**	**20**

BSC = Basic Science Course, ESC = Engineering Science Course, PCC = Professional Core CoursePEC = Professional Elective Course, OEC = Open Elective Course, LC = Laboratory Course HSSMC = Humanities and Social Science including Management Courses

Elective II

Sr No	Course Code	Course Name
1	BTSFPE504A	First Aid and Occupational Health
2	BTSFPE504B	Mechanical Measurement and Control
3	BTSFPE504C	Artificial Intelligence

Open Elective I

Sr No	Course Code	Course Name
1	BTSFOE505A	Piping Design
2	BTSFOE505B	Robotics and Automation
3	BTSFOE505C	Internet of Things

Semester VI									
Course Category	**Course Code**	**Course Title**	**Teaching Scheme**			**Evaluation Scheme**				**No. of Credits**
			L	**T**	**P**	**CA**	**MSE**	**ESE**	**Total**	
PCC15	BTSFC601	Chemical and Process Safety Management	3	-	-	20	20	60	100	3
PCC16	BTSFC602	Fire Detection and Installation Fire Fighting System-I	2	-	-	20	20	60	100	2
PEC3	BTSFPE603A-C	Elective-III	3	-	-	20	20	60	100	3
PEC4	BTSFPE604A-C	Elective-IV	3	-	-	20	20	60	100	3
OEC2	BTSFOE605A-C	Open Elective-II	3	-	-	20	20	60	100	3
PCC17	BTSFCL606	Chemical and Process Safety Management Lab	-	-	2	60	-	40	100	1
PCC18	BTSFCL607	Fire Detection and Installation Fire Fighting System-I Lab	-	-	4	60	-	40	100	2
		Competitive Skills	-	-	-	-	-	-	-	(Audit Course)
LC4	BTSFD608	Drill- 4	-	-	4	50	-	-	50	2
		Total	**14**	**-**	**16**	**450**	**100**	**500**	**1050**	**19**

BSC = Basic Science Course, ESC = Engineering Science Course, PCC = Professional Core CoursePEC = Professional Elective Course, OEC = Open Elective Course, LC = Laboratory Course HSSMC = Humanities and Social Science including Management Courses

Elective III

Sr No	Course Code	Course Name
1	BTSFPE603A	Fire Service Hydraulics
2	BTSFPE603B	Fire Smoke and Dynamics
3	BTSFPE603C	Passive Measures for Fire Safety

Elective IV

Sr No	Course Code	Course Name
1	BTSFPE604A	Hazards Identification and Risk Assessment
2	BTSFPE604B	Advanced Safety Engineering and Management
3	BTSFPE604C	Fire & Arson Investigation

Open Elective II

Sr No	Course Code	Course Name
1	BTSFOE605A	Electronics and Sensors
2	BTMOE605C	Energy Conservation and Management (Mechanical Elective)
3	BTSFOE605C	Transportation System and Safety

SEMESTER III

Subject Title: Safety Management

PCC1	BTSFC301	Safety Management	3-0-0	Credit 3

Teaching Scheme:	**Examination Scheme:**
Lecture: 3 hrs./week	Continuous Assessment: 20 Marks Mid Semester Exam: 20 Marks End Semester Exam: 60 Marks (Duration 03 hrs.)

Course Outcomes: At the end of the course, students will be able to

CO 1	Prevent accident while working at different levels by following work permit systems
CO 2	Design proper ventilation system and noise control system
CO 3	Use appropriate area for safe working and take necessary preventive measures
CO 4	Recommend appropriate techniques from prevention of accidents
CO 5	Prevent from fire accidents

Mapping of Course outcomes with program outcomes

Course Outcomes	Program Outcomes									
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO10
CO 1						1				
CO 2		3	1							
CO 3				2						
CO 4			1							
CO 5							2			

All units carry 12 Marks each for End Semester Examination.

Course Contents:

Unit 1 Safety Organization (8 Hrs.)

Safety Policy and Procedures, Management Objectives and Planning, Safety committee, First Aid Facilities Employee Involvement, Documentation and Information Control, Safety awareness

Unit 2 Area Classifications: (10 Hrs.)

Introduction, Controlled Area, Restricted Area, Hazardous Area, Non-Hazardous Area, Hazardous Area Classification, Class, Grouping of Flammable or Combustible Materials:
Class I Materials Gases and Vapors
Class II Materials – Dust, air suspended particles
Class III Combustible Fibers

Division:
Relationship between Division and Zone
Area Classification for Work Permits
Work Permit Area
Work Permit Free Area

Unit 3 Management Control Systems (10 Hrs.)
Permits to Work Systems, Hot work, working in confined space, Start-up and Shut-down of plant, working at Height, Personal Protective Equipment's (PPE), Respiratory Protection, Management of Noise, Control over Contractors.

Unit 4 Accident/Incident/Near Miss Reporting (10 Hrs.)
Definition of Accident, Reportable, Non- Reportable accidents, Fatal, Non-Fatal. Near miss accident. Lost time accident. Disabling Injury, Temporary Disablement and Permanent Disablement Partial and Total Disablement, Reporting systems, Investigation procedures, Accident/Incident Statistics and Measures of Performance.

Unit 5 Fire Control Systems (10 Hrs.)
Fire Risk Assessment (Key Elements), Fire Documentation, Alarm Systems, Fire Fighting Equipment, Emergency/Escape Lighting, Evacuation Drill and Instruction, Fire Risk Management Inspection, Escape Routes and Exits, Security, Emergency Planning.

Learning Resources:

1. **Books**

Sr No	Author	Title
1	Heinrich H. W	Safety code for Scaffolds and Ladders
2	Antiac (Lepburn, H.A.)	The Fundamental Causative Factors of an Industrial Accidents
3	Ghiselli, F. E	The Myth of Accident Proneness
4	Schulzinger M. S	The Accident Syndrome
5	Nilesh B. Ukunde	Early Warning Smoke detection cum Fire Alarm System

2. **List of Websites:**

1. http://www.osha-slc.gov/SLTC/machineguarding/index.html
2. http://www.machinetoolsupplier.com/Buy-Used-Machine-Tools-and-CNCMachines-
3. http://www.noise-vibration.co.uk/

Subject Title: Fire Engineering Science

PCC2	BTSFC302	Fire Engineering Science	3-0-0	Credit 3

Teaching Scheme:	**Examination Scheme:**
Lecture: 3 Hrs./week	Continuous Assessment: 20 Marks Mid Semester Exam: 20 Marks End Semester Exam: 60 Marks (Duration 03 hrs.)

Course Outcomes: At the end of the course, students will be able to

CO 1	Identify combustible matter
CO 2	Handle different combustible matter according to its properties
CO 3	Differentiate the type of Fire
CO 4	List the extinguishing media or agent and use of it accordingly
CO 5	Diagnose the cause of fire
CO 6	Select the fire extinguishing method according to type of fire

Mapping of Course outcomes with program outcomes

Course Outcomes	Program Outcomes									
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO10
CO 1		2								
CO 2										
CO 3										
CO 4		1								
CO 5		1		2						
CO 6										

All units carry 10 Marks each for End Semester Examination.

Course Contents:

Unit 1 (10 Hrs.)

1.1 Combustible Matter: Combustible Solids, Physical and Chemical properties of Combustible Solids,

1.2 Combustible Liquids: Physical and Chemical properties of Flammable/ Combustible Liquids, Explosivity and flammability range, Auto ignition temperature, Spontaneous combustion, Combustible Liquids Oils Hydrocarbons, Residue from stored Hydrocarbons, Classification of petroleum liquids as per NFPA

1.3 Combustible Gases: Physical and Chemical properties of Combustible Gases, toxic or infectious, corrosive etc.

Unit 2 (9 Hrs.)

2.1 Combustion: Combustion and its types, oxygen content in air by weight and volume,

2.2 Combustion of solid, liquid and gases, Exothermic and Endothermic reactions, Jet and flash, flames and its types, premixed, diffusion, turbulent, stationary and propagating flames, Burning velocity, Flash point, Fire point

2.3 Transmission of heat by conduction, convection and radiation.

Unit 3 (8 Hrs.)

3.1 Fire: Definition of Fire, Fire Triangle, Tetrahedron of Fire, Classification of Fires.

3.2 Types of extinguishing media or Agent, Principles of Fire extinguishing methods. Cooling, Starvation, smothering (Blanketing), Retarding chain reaction.

Unit 4 (8 Hrs.)

4.1 Fire extinguishing media or agents, Extinguishing property of water, Characteristics of ideal liquid extinguishing agent, various forms of water like solid stream, fog, spray.

Unit 5 (7 Hrs.)

5.1 Foam: Types of foam concentrate, Protein, AFFF, fluoro protein, Alcohol type, Low, medium and high expansion foam, Physical and chemical properties of foam.

Learning Recourses:
Books:

Sr No	Author	Title	Publisher
1	B. Lewis and G.Ven, Elbe	Cases of Combustion, Flame and Explosion	Academic Press
2	C.W Bahme	Fire officer's guide to dangerous Chemicals	NFPA
3	National Fire Protection Association (NFPA)	Low Expansion Foam, National Fire Protection Association, Volume 11	NFPA
4	NFPA	Carbon dioxide Extinguishing Systems, NPFA volume 12	NFPA
5	NFPA	Dry Chemical Extinguishing Systems, National Fire Protection Association, Volume 17	NFPA

6	HMSO	Manual of firemanship part- 6 c	HMSO
7	G. C. Mishra	Concepts and Calculations, Fire Service Hydraulics.	Technip Books International

1. **VIDEO CASSETTES/ CDS:**

i) Foam. VC07, Academia Books International Pvt. Ltd.
ii) Fire Scenario and Simulator. VC09, Akademia Books International Pvt. Ltd.
iii) Fire Concepts and Behavior VC29 NFPA
iv) Fire Power. Vc30, NFPA

IS/ INTERNATIONAL CODES

IS 4308:1982 Specification for dry powder for firefighting (1st revision) Dec. 1998.
IS 4861:1984 Specification for dry powder for fighting fires in burning metals (1st revision) June 2000.
IS 4989(Part-I): 1985 Specification for foam concentrate (compound) for producing mechanical foam for firefighting – Part-I, Protein foam (2nd revision) June 2000.
IS 4989(Part-II): 1984Specification for foam concentrate for producing mechanical foam for firefighting: part-II Aqueous Film Forming Foam - June 2000
IS 4989(Part-III):1987 Specification for foam concentrate (compound) for producing foam for firefighting: Part-III Fluoro Protein foam.
IS 11833:1986 Specification for dry powder fire extinguisher for metal fires.Aug. 2000.
IS 14609:1999 Specification for ABC dry powder for firefighting.

Subject Title: Mechanical Engineering Drawing

ESC10	BTES303	Mechanical Engineering Drawing	3-0-0	Credit 3

Teaching Scheme:	**Examination Scheme:**
Lecture: 3 Hrs./week	Continuous Assessment: 20 Marks Mid Semester Exam: 20 Marks End Semester Exam: 60 Marks (Duration 04 hrs.)

Course Outcomes: At the end of the course students will be able to demonstrate following course objectives for parts and assembly parenting to Fire and Safety Engineering

CO 1	Develop surface for different solid
CO 2	Trace curve of intersection of various solid
CO 3	Use various drawing codes and symbols
CO 4	Draw production drawing
CO 5	Draw assembly and details drawing
CO 6	Draw detail drawing from assembly

Mapping of Course outcomes with program outcomes

Course Outcomes	Program Outcomes									
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO10
CO 1	1		2							
CO 2	1		2							
CO 3										
CO 4										
CO 5	1									
CO 6	1									

Course Content

Unit 1: Development of Surfaces (8 Hrs.)

1.1 Developments of Lateral surfaces of cube, prism, cylinder, pyramid, cone

1.2 Applications such as tray, funnel, Chimney, pipe bends etc.

Unit 2. Intersection of Solid (8 Hrs.)

Visualize and draw Curves of intersection of the surfaces of different solids Curves of intersection of the surfaces of the solids in the following cases

2.1 Prism with prism, Cylinder with cylinder, Prism with Cylinder When (i) the axes are at 90° and intersecting (ii) The axes are at 90° and Offset

2.2 Cylinder with Cone When axis of cylinder is parallel to both the reference planes and cone resting on base on HP and with axis intersecting and offset from axis of cylinder

Unit 3. Conventional Representation (6 Hrs.)

Understand and draw the projection of Conventional Representation

3.1. Standard convention using SP – 46 (1988)

3.2 Materials- C.I., M.S, Brass, Bronze, Aluminium, wood, Glass, Concrete and Rubber

3.3 Long and short break in pipe, rod and shaft.

3.4 Ball and Roller bearing, pipe joints, cocks, valves, internal / external threads.

3.5 Various sections- Half, removed, revolved, offset, partial and aligned sections.

3.6 Knurling, serrated shafts, splined shafts, and keys and key ways

3.7 Springs with square and flat ends, Gears, sprocket wheel, chain wheels

3.8 Countersunk & counter bored holes.

Unit 4: Limit Fit and Tolerances (6 Hrs.)

4.1 Definitions, Introduction to ISO system of tolerancing- unilateral and bilateral and its representation on drawing, dimensional tolerances, elements of interchangeable system, hole & shaft base systems, tolerance diagram, Selection of fit (clearance, transition and interference) for Fire and Safety applications.

4.2 Geometrical tolerances: Definitions, Tolerances of form and position and its geometric representation-tolerance frame, datum feature, magnitude of tolerance and symbol, interpretation of a given symbol on drawing, simple examples.

4.3 General welding symbols Symbolic representation in Engineering practices and its interpretation.

4.4 Characteristics of surface roughness: Indication of machining symbol showing direction of lay, roughness grades, machining allowances, manufacturing methods, using ISO code. Relation of surface roughness values with manufacturing processes.

Unit 5 Assembly Drawing (10 Hrs.)

Visualize and draw Details to Assembly and understand the procedure for assembly of components

5.1 Introduction- Basic principles of process of assembly.

5.2 Couplings - Assembly of Universal couplings & Oldham's Coupling

5.3 Bearing - Assembly of Foot Step Bearing & Pedestal Bearing

5.4 Assembly of Machine Vice & Pipe Vice

5.5 Assembly of Screw Jack

5.6 Assembly of Valves- Steam Stop Valve, Non - Return Valve

Learning Resources

1. N.D. Bhatt – Machine Drawing – Charter Publication, Anand reprint 2010
2. L.K. Narayanan, P. Kannaich, K.Venkatreddy – Production Drawing - New Age international Publication 2014.
3. N. Siddheshwar, P. Kannaiha – Machine Drawing –Tata Mg Hill Publication

Subject Title: Mechanics of Fluids

ESC11	BTES304	Fluid Mechanics	3-0-0	Credit 3

Teaching Scheme:	**Examination Scheme:**
Lecture: 3 Hrs./week	Continuous Assessment: 20 Marks Mid Semester Exam: 20 Marks End Semester Exam: 60 Marks (Duration 03 hrs.)

Course Outcomes: After learning the course, the students should be able to

CO 1	Investigate pressure & pressure head
CO 2	Identify fluid flow behavior under different operating conditions
CO 3	Apply Bernoulli's equation for Venturi meter, Orifice meter and Pitot tube
CO 4	Calculate the discharge and losses through pipes and different firefighting hoses
CO 5	Apply water jets in fire protection services
CO 6	Inspection and testing of water supply systems and hydrants used in fire protection services
CO 7	Apply principles of fluid mechanics to the design, selection and operation of pumps

Mapping of Course outcomes with program outcomes

Course Outcomes	Program Outcomes									
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO10
CO 1			2		2					2
CO 2			2							2
CO 3			2	3	2				1	2
CO 4			2	3					1	2
CO 5			2						1	2
CO 6			3	3	2	2	2		1	1
CO 7				2	2	1			1	1

All units carry 10 Marks each for End Semester Examination.

COURSE CONTENTS:

Unit 1: Introduction of Fluid Mechanics and Fluid Statics (08 Hrs.)

1.1 Physical properties of fluids: Mass density, specific weight, specific volume, specific gravity, viscosity, surface tension, Rheological classification of fluids.

1.2 Fluid Statics - Pressure at a point - Basic equation of fluid statics, Atmospheric pressure, gauge pressure and vacuum pressure, Pressure measurement by manometers and pressure gauges.

1.3 Hydrostatic force on a submerged plane and curved surfaces, Buoyancy and equilibrium of floating bodies

Unit 2: Fluid Kinematics and Fluid Dynamics (08 Hrs.)

2.1 Lagrangian and Eulerian approaches, Classification of fluid motions - path line, stream line, streak line, stream tube

2.2 Classification of flows, Equation of continuity for one-dimensional flows, equation of stream line, stream function, and velocity potential function

2.3 Fluid dynamics - Equations of motion, Euler´s equation along a streamline, Bernoulli´s equation and its applications - Venturi meter, Orifice meter, and Pitot tube.

Unit 3: Flow through Pipes (08 Hrs.)

3.1 Reynold's experiment, Laminar flow through circular pipe, Major energy losses, Minor energy losses, Hydraulic gradient and total energy lines,

3.2 Pipes in series and parallel, Equivalent pipes, Water hammer in pipes

Unit 4: Impact of Jets (06 Hrs.)

4.1 Introduction, force exerted by fluid jet on stationary flat plate, normal to the Jet and inclined to the Jet, force exerted by fluid Jet on moving flat plate, force exerted by a fluid Jet on moving curved vane.

Unit 5: Water Supply and Hydrant Systems (08 Hrs.)

5.1 Use of water in fire protection service, Water supply systems, Analysis of Water supply systems

5.2 Hydrants and their types, hydrant gear and characteristics, inspection and testing of hydrants

Learning Recourses:

Books:

Sr No	Author	Title	Publisher
1	Dr. R. K. Bansal	Fluid Mechanics and Hydraulic Machines	Laxmi Publications (P) Ltd.
2	D.S. Kumar	Fluid Mechanics and Fluid Power Engineering	Kotaria and Sons
3	D. Rama Durgaiah,	Fluid Mechanics and Machinery	New Age International.
4	Banga & Sharma	Hydraulic Machines	Khanna Publishers

5	Streeter, V.L. and Wylie, E.B.,	Fluid mechanics	McGraw Hill, New York.
6	Vasandani, V.P.,	Hydraulic machines - Theory and Design	Khanna Publishers, New Delhi.
7	Domkondwar	Fluid Mechanics and Hydraulic Machines,	Dhanpatrai and Co.
8	Emmons, D.D.	Ceiling Jet Flows, SFPE Handbook	1st Edition, ed. P.J. Di Nenno (Society of Fire Protection Engineers, Boston), Ch. 1-9
9	Heskestad, G.	Fire Plumes, SFPE Handbook	1st Edition, ed. P.J. Di Nenno (Society of Fire Protection Engineers, Boston), Ch. 1-6.

Subject Title: Business Communication Skill

HSSMC3	BTHM305	Business Communication Skill	2-0-0	Credit 2

Teaching Scheme:	**Examination Scheme:**
Lecture: 3 Hrs./week	Continuous Assessment: 50 Marks

Course Outcomes: Learner(s) will be able to

CO 1	Accumulate, review, mediate accurate information and transmit technical ideas, policies with greater clarity & precision
CO 2	Draft, revise and edit technical drafts, letters, proposals, applications, with effective linguistic skills and abilities by eliminating grammatical errors in the same
CO 3	Absorb, inculcate and practice an industrial ethics, professional work culture and collaborate effectively in organizational communication system
CO 4	Lead, present and communicate business strategies persuasively and convincingly through result-oriented endeavors both verbally and non-verbally within and outside organizations

Mapping of Course outcomes with program outcomes

Course Outcomes	Program Outcomes									
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO10
CO 1		1								
CO 2		2								
CO 3				1				2	2	
CO 4									2	2

Course Contents:

Unit 1: Professional Writing Skills (04 Hours)

- Professional Writing: Meaning & Scope
- Professional Writing: purpose and objectives
- Drafting with purpose
- Basic Grammatical Errors

Unit 2: Official Correspondence (08 Hours)

- Office Correspondence: Notices, Memo & Circulars, etc.
- Business Correspondence: Inquiry, Order, Complaint letters
- Letter Writing: Formal and Personal
- Report Writing: Factual, Progress, Feasibility, Survey, etc.
- E-mailing Etiquettes

Unit 3: Editing, Revising and Proof Reading (08 Hours)

- Editing & Translation Techniques.
- Manuals, Brochures & Leaflets
- Articles & Business Proposals
- Note-Making Techniques.
- The Art of Condensation.
- Summarizing and Conclusion.

Unit 4: Professional Morals, Ethics & Codes (05 Hours)

- Business Ethics & Morals
- Managing Time and Punctuality
- Conflict-management
- Problem-Solving Techniques
- Loyalty, Integrity, & Professionalism

Unit 5: Presentation Skills (05 Hours)

- Presentation Skills
- Non-verbal Communication
- Power Point Presentation
- Using Audio-Visual Aids

List of Practical / Assignments:

1. Drafting activities based on con-current events, happenings for print as well as online media.
2. Identification and elimination of basic grammatical errors in sentences, paragraphs and content.
3. Drafting activity based on business correspondence, letter writing and report writing.
4. Drafting emails for distinguished situations, in professional work culture.
5. Drafting, Editing and Proof-Reading activities based on appropriate content in English.
6. Condensation, summarizing activities based on appropriated content in English.
7. Giving Presentations, seminars on suitable topic using PPTs to improve presentation skills.
8. Arrange elocution, extempore in the classroom on current topics in the social scenario.
9. Arrange group discussion, expert interview sessions, and mocks in the classroom.
10. Preparation of articles, brochures, manuals for professional purpose.
11. Presentation activities in the classroom for professional development of the learners.

12. Brain storming and problem-solving activities should be arranged in the classroom.

Note: This is the suggestive list of assignments / practical to be conducted in the classroom / language lab. However, the subject teacher is free to set, design new assignment / practical's in relevance with the subject content.

(Any eight assignments to be conducted and submitted to the subject teacher to form the record of the subject).

Text Books:

1. Meenakshi Raman and Sangeeta Sharma *Technical Communication Principles and Practice*, Third Edition. OXFORD University Press, New Delhi, 2015.
2. Dale Jung, k., *Applied Writing for Technicians*, McGraw Hill, New York, 2004. (ISBN: 07828357-4)
3. Sharma, R. and Mohan, K. *Business Correspondence and Report Writing*, TMH New Delhi 2002.
4. Dr. Alandkar N. V. *Effective Communication Skills*, GRACE, Nanded, 2019.

Reference Books:

1. David F. Beer and David McMurrey, *Guide to writing as an Engineer*, John Willey. New York, 2004
2. Diane Hacker, Pocket Style Manual, Bedford Publication, New York, 2003. (ISBN 0312406843)
3. Shiv Khera, *You Can Win*, Macmillan Books, New York, 2003.

Subject Title: Safety Management Lab

PCC3	BTSFCL306	Safety Management	0-0-2	Credit 1

Teaching Scheme:	**Examination Scheme:**
Lecture: 2 hrs./week	Continuous Assessment: 60 Marks End Semester Exam: 40 Marks

List of Practical's/Experiments/Assignments (any eight experiments from the list)

1. Study of personal protective equipment
2. Assessment of the safety performance of an industry and classification of accidents
3. Safety assessment of a construction site
4. Environmental impact assessment and environmental audit
5. Accident reporting exercises
6. Job safety analysis exercises
7. Safety audit exercises example labs workshop academic administrative and recent residential buildings
8. Calculation of cost of accidents
9. Preparation of work permits
10. Preparation of training module on any topic of safety for a target audience
11. Assignment on each unit

Subject Title: Fire Engineering Science Lab

PCC4	BTSFCL307	Fire Engineering Science	0-0-2	Credit 1

Teaching Scheme:	**Examination Scheme:**
Lecture: 2 Hrs./week	Continuous Assessment: 60 Marks End Semester Exam: 40 Marks

List of Practical's/Experiments/Assignments

1. Study of different combustible matter of solid, liquid and gas
2. Calculate the flash point and fire point by bomb calorimeter
3. Analyze Extinguishing medium cooling, starvation and smoothering
4. Identify different Extinguishing Agents
5. Study the different dry chemical powder and list down its properties
6. Study the different types of foam
7. Assignment on each unit

Subject Title: Mechanical Engineering Drawing Lab

ESC12	BTESL308	Mechanical Engineering Drawing Lab	0-0-4	Credit 2

Teaching Scheme:	**Examination Scheme:**
Practical: 4 Hrs./week	Continuous Assessment: 60 Marks End Semester Exam: 40 Marks

List of Practical's/Experiments/Assignments

1. Any two problems on development of surfaces of different objects. - (1 Sheet and 1 in CAD)
2. Any two sheets on intersection of solids (1 Sheet and 1 in CAD)
3. Conventional Representation of machine components as per SP – 46 (1988) - one sheet
4. Limit, Fit, Tolerances, geometric tolerances, Machining Symbols, welding symbols – one sheet
5. Two problems on assembly drawing using any CAD package with at least 6 components including conventional representation, tolerances, surface finish symbols, Part list.
6. Detail drawing – From given drawing draw any two problems on dismantling of assembly having minimum 6 parts. Draw details in any CAD package.

Subject Title: Fluid Mechanics Lab

ESC13	BTESL309	Fluid Mechanics Lab	0-0-2	Credit 1

Teaching Scheme:	**Examination Scheme:**
Practical: 2 Hrs./week	Continuous Assessment: 60 Marks End Semester Exam: 40 Marks

List of Practical's/Experiments/Assignments (any 8 experiments from the list)

1. To determine pressure acting at any point by using manometers.
2. To determine meta centric height of floating body
3. To Verify Bernoulli's theorem.
4. To determine the co-efficient of discharge of the given Venturi meter
5. To determine the co-efficient of discharge of the given Orifice meter
6. To determine the co-efficient of friction (Darcy's constant) for Pipes of different diameters.
7. To study pipe fittings.
8. To determine the minor losses due to sudden enlargement, sudden contraction and bends
9. Determine the coefficient of resistance for various types of minor losses.
10. To determine the co efficient of impact for vanes.
11. To study water supply system and type of hydrants.
12. Determine the efficiency of centrifugal pump.
13. Determine the efficiency of reciprocating pump.

List of Instrument/Apparatus;

1. Manometer test rig
2. Bernoulli's Apparatus
3. Venturimeter test rig
4. Orifice Meter test rig
5. Losses of friction through pipes Apparatus
6. Losses of friction through pipe fitting apparatus
7. Centrifugal Pump test rig
8. Reciprocating Pump test rig
9. Losses in pipes due to Sudden Enlargement, Contraction and bends Apparatus

Internship – 1 Evaluation

BTES209P (Internship – 1)	Internship – 1 Evaluation	PROJ-1	0L-0T-0P	1 Credits

Teaching Scheme:	**Examination Scheme:**
Lecture: --	Continuous Assessment: -- Mid Semester Exam: -- End Semester Exam: 100 Marks

Drill-I

LC-1	BTSFD310	Drill-I	0-0-4	Credit 2

Teaching Scheme:	**Examination Scheme:**
04 Hrs./week	Continuous Assessment: 50 Marks

Practical syllabus based on Standard Drill Manual as well as Code and Practice

Group A- Squad Drill

Group B- Fire Drill

Books Recommended:

1. Fire Service Manuals U.K.

2. NFPA U.S.A.

SEMESTER IV

Subject Title: Safety in Engineering Industry

PCC5	BTSFC401	Safety in Engineering Industry	3-0-0	Credit 3

Teaching Scheme:	**Examination Scheme:**
Lecture: 3 Hrs./week	Continuous Assessment: 20 Marks Mid Semester Exam: 20 Marks End Semester Exam: 60 Marks (Duration 03 hrs.)

Course Outcomes: At the end of the course, students will be able to

CO 1	Know fundamentals of manufacturing processes
CO 2	Control the various working activities during manufacturing process
CO 3	Prevent the accidents in the industries
CO 4	Gained idea about hazards and safe operation techniques in a manufacturing industry
CO 5	Develop SOP for any machine in the industries

Mapping of Course outcomes with program outcomes

Course Outcomes	Program Outcomes									
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO10
CO 1	3									
CO 2	1	2		1						
CO 3						3				
CO 4		1				3				
CO 5					2	2				

All units carry 12 Marks each for End Semester Examination.

Course Content:

Unit 1 Introduction: (8 hrs.)
1.1 Introduction to various hot and cold processes in engineering industry including manufacture of various grades of steel

Unit 2 Hot Working (12 hrs.)
2.1 Foundry operation:
Flow sheet for foundry operation including use of different types of furnaces in each of the operation.
Health hazards and safe methods of operation. Die casting. Fettling operations, short blasting, sand blasting
2.2 Forging Operation:

Hazards in forging operations. Preventive maintenance of forging machines. Safe work practices in forging operations. Safety in the use, handling and storage of dies. Safety on die changing.

2.3 Hot Rolling Mills Operation:

Identify Hazards in hot rolling operations and their control measures, safety in hot rolling mills.

Unit 3 Cold Working (10 hrs.)

3.1 Safety in the use of 1) power presses (all types) 2) shearing, 3) bending, 4) rolling, 5) drawing, 6) turning, 7) drilling, 8) boring, 9) milling, shaping 10) planning broaching, 11) grinding, 12) Computerized Numerically Controlled Systems.

3.2 Need for selection and care of cutting tools. Preventive maintenance, periodic checks for safe operation. Associated hazards and their prevention.

3.3 Safety in the machine tools.

Unit 4: Other Operations (10 hrs.)

4.1 Safety precaution in 1) Welding 2) Cutting 3) Brazing, 4) Soldering and Metalizing and Chiseling, Blasting Operations.

4.2 Safety in selection, care and maintenance of the associated equipment and instruments.

4.3 Safety in finishing operation like a) cleaning b) polishing and c) buffing and their d) related hazards. Safety in maintenance and use of these machines.

Unit 5: Heat Treatment: (8 hrs.)

5.1 Control and Prevention of Hazards in various heat treatment operations.

Reference Books:

Sr No	Author	Title	Publications
1	NSC	Forging Safety Manual (Chapter on Heat Treatment	National Safety Council, U.S.A.
2	H.I. Sax	Hand Book of Dangerous Materials	Reinhold Publishing Corporation, M.Y.U.S.A.
3	Raymond A. Higgins	Engineering Metallurgy	The English Language Book Society, London
4	NFPA	National Fire Codes, Vol. I	National Fire Protection Association, Boston, Massachusetts, U.S.A

Subject Title: Fire Service Equipment & Appliances

PCC6	BTSFC402	Fire Service Equipment & Appliances	3-0-0	Credit 3

Teaching Scheme:	**Examination Scheme:**
Lecture: 3 Hrs./week	Continuous Assessment: 20 Marks Mid Semester Exam: 20 Marks End Semester Exam: 60 Marks (Duration 03 hrs.)

Course Outcomes: At the of the course, students will be able to

CO 1	Identify & label various fire service equipment's
CO 2	Select fire service equipment for proper application
CO 3	Apply various fire service equipment in different fire types
CO 4	Identify various operations for a particular equipment
CO 5	Diagnose fault in fire service equipment
CO 6	Select methods of maintenance of equipment's

Mapping of Course outcomes with program outcomes

Course Outcomes	Program Outcomes									
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO10
CO 1	2									
CO 2							2		1	
CO 3			2		3				3	
CO 4					2		3		2	
CO 5				3						
CO 6										

All units carry 10 Marks each for End Semester Examination.

Course Contents:

Unit 1: Hydrants & Water Supply (14 Hrs.)

1.1 Distribution of water supplies, water resource for firefighting, Classification of hydrant system, code of practice in respect of requirements and standardization of hydrants

1.2 Hose fittings: Standard couplings, Foam branches & nozzles including special types. Branch holders. Collecting heads and suction Hose fittings with references to BS1.

1.3 Hydraulics: Characteristic of suction lift & atmospheric pressure, Pump- power & efficiency, types of pumps & its merits & demerits, centrifugal pump & its characteristics, priming

Unit 2: Breathing Apparatus (7 Hrs.)

2.1 Introduction and need / importance of Breathing Apparatus in Fire Services. Compressed air Breathing Apparatus — Description of set, face-mask and demand valve whistle manifold

and reducer, communication equipment, rescue with breathing apparatus- Do's & Don'ts
2.2Different methods of manual resuscitation

Unit 3: Fire Extinguishers (8 Hrs.)

3.1 Construction and practical use of Water types extinguishers, Foam and mechanical Foam extinguishers, dry chemical powder extinguishers and Vapor forming —Liquid or gas extinguishers

3.2 Inspection, testing and Maintenance procedure for of all types of fire extinguishers as per BS1 2190 / BS1 15683

Unit 4: Fixed Fire Fighting Installation & Foam Making Equipment

4.1 Fixed Fire Fighting Installation**:** Purpose and principle of Installation, Types of installation- Manual and automatic, suppression and their use, care and maintenance as per NBC

4.2 Foam making Equipment: Foam making equipment, care and maintenance of foam making equipment reference to relevant BS1.

Unit 5: Ladders (6 Hrs.)

5.1 Introduction of sophisticated aerial ladder. Construction. use, testing and maintenance of Turn table ladder (TTL) and hydraulic Platform, Standard drills, Rescue using aerial ladder.

Learning Resources:
Books:

Sr No	**Author**	**Title**	**Publisher**
1	Carl Goodson	Essentials of fire fighting	Fire protection publications
2	Pann Well	Fire engineering's skill drills for Fire Fighter	Pann Well; 1st & 2nd edition
3	South Metropolitan Australian Fire Service **(SMAFS)**	Fire Fighting Systems & Equipment in Buildings	SMAFS
4	Ronald Spadafora	Fire protection Equipment & Systems	Pearson; 1st edition (16 October 2014)

IS/ INTERNATIONAL CODES

IS 11833:1986 Specification for dry powder fire extinguisher for metal fires.Aug. 2000.

IS 14609:1999 Specification for ABC dry powder for firefighting.

BS 5306-1:2006 Code of Practice for Fire Extinguishing Installations and Equipment on Premises. Hose Reels and Foam Inlets.

BS 5306-2:1990 Fire Extinguishing Installations and Equipment on Premises. Specification for Sprinkler Systems

BS 5306-3:2017 Fire Extinguishing Installations and Equipment on Premises. Commissioning and Maintenance of Portable Fire Extinguishers. Code of Practice

BS 5306-8:2012 Fire Extinguishing Installations and Equipment on Premises. Selection and Positioning of Portable Fire Extinguishers. Code of Practice

NFPA 10: Standard for portable fire extinguishers

NFPA 13: Standard for the installation of sprinkler system

NFPA 14: Standard for the installation of standpipe & hose system

NFPA 15: Standard for water spray fixed systems for fire protection

NFPA 20: Standard for the installation of stationary pumps for fire protection

Subject Title: Fire Codes & Standards

PEC1	BTSFPE403A	Fire Codes & Standards	4-0-0	Credit 4

Teaching Scheme:	**Examination Scheme:**
Lecture: 4 Hrs./week	Continuous Assessment: 20 Marks Mid Semester Exam: 20 Marks End Semester Exam: 60 Marks (Duration 03 hrs.)

Course Outcomes: At the of the course, students will be able to

CO 1	Specify different fire- fighting equipment
CO 2	Select codes & standards related to construction & design of building
CO 3	Select various codes for different firefighting devices
CO 4	Select codes & specifications related to safety of firefighting personnel
CO 5	Select codes & laws related to industrial, municipal & state life safety

Mapping of Course outcomes with program outcomes

Course Outcomes	Program Outcomes									
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO10
CO 1	2									
CO 2					2		2			3
CO 3					2		2			3
CO 4					2		2			3
CO 5					2		2			3

All units carry 12 Marks each for End Semester Examination.

Course Contents:

Unit 1 (9 Hrs.)

Specification of fire-fighting equipment- specification of valves, pipes installation, specification of supports & clamps, specification of sprinkler system, specification of fire hydrant system, specification of fire pump, fire door details

Unit 2 (10 Hrs.)

Code & Standards concerning construction & Design of building- classification of building based on occupancy, fire zones, types of construction, fire protection requirement for high rise buildings, guidelines for fire drill & evacuation procedure for high rise building

Unit 3 (10 Hrs.)

International code & standard for Hydraulic platform, classification of hydraulic platforms, specification for aerial ladder platform (ALP), Highly developed rescue cage, specification of first attack vehicles, Turntable ladder and other Rescue and fire-fighting devices and components.

Unit 4 (10 Hrs.)
Need for personal protective equipment, Code, Standard and specification concerning to safety of fire-fighting personnel i.e., Breathing Apparatus P.P.E., parts of fire fighter PPE, configurations of fire fighters PPE, fire gloves, helmet, face mask, safety gears.

Unit 5 (9 Hrs.)
Code, Standard and bye laws concerning Industrial safety- general safety, occupational safety, workplace safety, electrical safety, environmental safety, Municipal and State life safety & fire protection measures.

Learning Resources:

Books:

1. NBC, B.I.S, DIN, EU, B.S., UL, FM Code & Standards, EN. Standards C.E. Australian codes.
2. DGMS, Director general of mines. Safety and mines regulations.
3. All relevant standards specification, codes and practice National & International Stand

IS/ INTERNATIONAL CODES

NFPA 3: Standards for Commissioning of Fire Protection & Life Safety Systems

NFPA 4: Standard for integrated Fire Protection & life safety system Testing

NFPA 72: National Fire Alarm & Signaling Code

NFPA 79: Electrical Standards for Industrial Machinery

NFPA 80: standard for Fire Doors & Other Opening Protective

NFPA 80A: Recommended Practice for Protection of Buildings from Exterior fire Exposures

NFPA 101A: Guide on Alternative Approaches to Life Safety

NFPA 101B: Code for Means of Egress for Building & Structures

NFPA 220: Standard on Types of Building Construction

Subject Title: Fire Laws

PEC1	BTSFPE403B	Fire Laws	4-0-0	Credit 4

Teaching Scheme:	**Examination Scheme:**
Lecture: 4 Hrs./week	Continuous Assessment: 20 Marks Mid Semester Exam: 20 Marks End Semester Exam: 60 Marks (Duration 03 hrs.)

Course Outcomes: At the of the course, students will be able to

CO 1	Understand legal concepts and their application in the Fire Service.
CO 2	Analyze torts, crimes, and liability in relation to intention, negligence, and disciplinary actions.
CO 3	Explore governmental liability and the doctrine of sovereign immunity in India.
CO 4	Examine evidence and criminal procedures, code enforcement, and standards.
CO 5	Compare existing legislation with the U.K. Fire Services Act and study case studies on compensation laws and fire safety.

Mapping of Course outcomes with program outcomes

Course Outcomes	Program Outcomes									
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO10
CO 1	2	1								
CO 2			1		2		2			3
CO 3					2		2			3
CO 4		1			2		2			3
CO 5	1				2		2			3

Unit: I (10 Hrs.)
Meaning of Juristic concepts, Viz., Contract, Right, Duty, Wrong substantive Law and Procedural Law, Case law Statute law, The Law and the Fire Service, The Law suit process, Judicial System, Legislatures and Statues.

Unit: II (09 Hrs.)
a) Tort and Crime
b) Intention, Negligence and Absolute Liability
c) Conditions, Incidence and Measure of Liability
d) Modern Trends
e) Disciplinary action

Unit: III (08 Hrs.)
a) Doctrine of Sovereign immunity;
b) Governmental liability in India with reference to the Indian Constitution

Unit: IV (08 Hrs.)

1. General Principles of Law of Evidence and Criminal Procedure (Relevant Provisions only)
2. Code and code enforcement
3. Standards and the Law

Unit: V (08 Hrs.)

Existing Legislation, their limitations and wide divergence between different legislations; A brief comparison with U.K. Fire Services Act of 1947; Model Fire Service Legislation, its scope and object.

BOOKS RECOMMENDED

1. I.P.C. Indian Penal Code, C.P.C., R.P.C.
2. General Fire Insurance
3. All relevant acts
4. Fire Service Acts and Rules of different State Fire Services of India.
5. Insurance Rule and Act
6. Fire Chief Hand Book

Subject Title: Urban Planning

PEC1	BTSFPE403C	Urban Planning	4-0-0	Credit 4

Teaching Scheme:	**Examination Scheme:**
Lecture: 4 Hrs./week	Continuous Assessment: 20 Marks Mid Semester Exam: 20 Marks End Semester Exam: 60 Marks (Duration 03 hrs.)

Course Outcomes: At the of the course, students will be able to

CO 1	Understand urban growth's impact on national development and cities as engines of growth.
CO 2	Explore city-region linkages and peripheral urban development.
CO 3	Analyze issues and sustainability concepts in metro and mega cities.
CO 4	Learn about human settlement planning and urban development strategies
CO 5	Gain knowledge of underground development, water supply, sanitation, and transportation planning in cities.

Mapping of Course outcomes with program outcomes

Course Outcomes	Program Outcomes									
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO10
CO 1	2	1				2				
CO 2			1				1		2	3
CO 3					2					3
CO 4		1					2			3
CO 5	1						2			3

Course Content

Unit: I (07 Hrs.)
Urban Growth and System of Cities: Growth of cities scale, complexity and its impact on national development, cities as engines of growth, cities as ecosystems, resources in cities.

Unit: II (06 Hrs.)
City – Region Linkages: City, fringe and the periphery - physical and functional linkages, peripheral -urban development.

Unit: III (10 Hrs.)
Metro and Mega Cities: Problems and Issues, Growth trends and processes, characteristics, problems, concepts and concerns of urban sustainability, concepts and concerns of urban sustainability, issues related to diversity and unintended growth, economic, social and environmental sustainability, quality of life, inclusivity and equity, climate change, transit oriented development, participatory planning. Inner city – issues and problems, approach to development.

Unit: IV (08 Hrs.)
Human Settlement Planning and Urban Development Concepts, approaches, strategies and tools, Policies and programmes at various levels, impact on metro and mega city development.

Unit: V (08 Hrs.)
Planning for under-ground development like metro rail, tunnels, market complexes and any other modern development.

Reference Books & Standards:
1. H. Miller, Patric Geddes, Routledge London Printer 1990
2. P.Healey, Planning Theory, Pergamon Press 1981
3. Andrews, Richard B. Urban growth and development: A problem approach. New York, SimmonsBoardman, 1962.
4. Ferguson, T; Benjamin, B.; Daley, Allen; Glass, D.V.; Mckeown, Thomas; Johnson, Gwendolyn Z; Mackintosh, J.M., Public health and urban growth, London, Center for Urban Studies, 1964
5. Robert, Introduction to town planning, Mnotype publishers, 1974
6. Browm A.J. Introduction to town and country planning
7. Wilson, Forrest, City planning : The games of human settlement, New York, Van Nostrandreinhold, 1975
8. Chowdhury, Anis; Kirkpatrick, Colin, Development policy and planning: An introduction to models and techniques, London, Routledge, 1994.
9. Ghosh, Pradip K. Ed., Development policy and planning: A third world perspective, England, Greenwood Press, 1984.
10. Ishwar Dayal; Mathur, Kuldeep; Datta, Abhijit; Banerjee, Utpal K., Dynamics of formulating policy in government of India machinery for policy development., Delhi, Concept Publishing, 1976
11. National Building Code, BIS

Subject Title: Thermodynamics and Heat Transfer

ESC14	BTES404	Thermodynamics and Heat Transfer	3-0-0	Credit 3

Teaching Scheme:	**Examination Scheme:**
Lecture: 3 hrs./week	Continuous Assessment: 20 Marks Mid Semester Exam: 20 Marks End Semester Exam: 60 Marks (Duration 03 hrs.)

Course Outcomes: At the end of the course, students will be able to

CO 1	Identify basic concept of thermodynamics used in the industries as well as in fire management
CO 2	Apply the fundamentals of second laws of thermodynamic to a wide range of systems
CO 3	Evaluate entropy changes in a wide range of processes and determine the reversibility or irreversibility of a process from such calculations
CO 4	Analyze heat conduction with and without internal heat generation, critical thickness of insulation with the practical utilities and mechanism of convection.
CO 5	Demonstrates the concept and mechanism of radiation
CO 6	Implement the design, performance analysis and practical applications of heat exchangers

Mapping of Course outcomes with program outcomes

Course Outcomes	Program Outcomes									
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO10
CO 1	1	1								
CO 2							1			1
CO 3										
CO 4					2					
CO 5										
CO 6			3							

All units carry 10 Marks each for End Semester Examination.

Course Contents:

Unit-1 (8 Hrs.)

1.1 Macroscopic and microscopic approach, thermodynamics systems, properties, point function and path function, process and cycle, thermodynamic equilibrium, quasi-static process, , work and heat transfer, P-dV and other types of work, temperature

1.2 Zeroth law of thermodynamics, principle of temperature measurement and various instruments, specific heat

1.3 The First Law of Thermodynamics: Joule's experiment, statement of the First law of thermodynamics for a cyclic and non-cyclic process, stored energy, perpetual motion machine of the first kind (PMM-I), energy balance in steady flow, some steady-flow devices

Unit-2 (8Hrs.)

2.1 Second law of thermodynamics: Limitations of the first law of thermodynamics, thermal reservoir, heat engine, refrigerator, heat pump, statements of the second law of thermodynamics

Unit 3 (8Hrs.)

3.1 Entropy: Introduction, Clausius theorem, Clausius inequality, Entropy and Irreversibility, Entropy principle and its application, combined I and II law, Entropy and direction, Entropy and disorder

3.2 Availability: Available energy pertaining a cycle T-S diagram, the increase-in- entropy principle, physical significance of entropy, T-ds relations, third law of thermodynamics.

Unit 4 (8Hrs.)

4.1 Conduction: Basic Concepts: Modes of heat transfer, Fourier's heat conduction equation, Concept of thermal conductivity.

4.2 General heat conduction equation in Cartesian coordinates, Conduction through systems at constant thermal conductivity: conduction through plane wall and composite slab.

4.3 Critical thickness of insulation and its importance. (Simple Numerical based on above)

4.4 Concept of convection, Free or Natural Convection: Application of dimensional analysis for free convection- physical significance of Grashoff number

4.5 Forced Convections: Applications of dimensional analysis for forced convection. Physical significance of Reynolds, Prandtl, Nusselt and Stanton numbers.

Unit 5 (8Hrs.)

5.1 Radiation Heat Transfer: Thermal radiation; definitions of various terms used in radiation heat transfer; Stefan-Boltzmann law, Kirchoff's law, Planck's law and Wein's displacement law.

5.2 Radiation heat exchange between two parallel infinite black surfaces. two parallel infinite gray surfaces; effect of radiation shield; intensity of radiation and solid angle; Lambert's law; radiation

Learning Recourses:
Books:

Sr. No	Author	Title	Publisher
1	Binay K Dutta,	Heat Transfer – Principles and Applications	Prentice hall of India
2	Er. R. K. Rajput	Heat and Mass Transfer	S Chand Technical publications
3	Hollman J.P	Heat Transfer	McGraw Hill.
4	K V Narayanan and B Lakshmikutty Amma	Mass Transfer Theories and Applications	CBS Publishers.
5	Binay K Dutta	Principles of mass transfer and Separation Processes	PHI Learning Private Limited
6	P. K. Nag	Engineering Thermodynamics	TMH
7	Rayner Joel	Basic Engineering Thermodynamics	Pearson Education
8	Incropera F P and Dewitt D P	Introduction to heat transfer	
9	M.Necati. Ozizik	Heat Transfer-A basic Approach	McGraw Hill
10	Kern D.Q	Process Heat Transfer,	McGraw Hill.
11	Van Wylen and Sontang, John Wiley	Engineering Thermodynamics	McGraw Hill
12	M. Achuthan	Engineering Thermodynamics	PHI
13	Eastop and McConkey	Applied Thermodynamics	Pearson
14	E. Rathakrishnan,	Fundamental of Engineering Thermodynamic	PHI
15	Russel and Adebiyi,	Engineering Thermodynamics	Oxford

Subject Title: CAD and Computer Proficiency

ESC15	BTES405	CAD and Computer Proficiency	4-0-0	Credit 2

Teaching Scheme:	**Examination Scheme:**
Lecture: 3 Hrs./week	Continuous Assessment: 50 Marks

Course Outcomes: At the of the course, students will be able to

CO 1	Setup the page layout in CAD software and take print of document
CO 2	Use draw and modify command for drawing 2-D sketch
CO 3	Create solid model using Boolean operation
CO 4	Assemble different parts by giving constrains
CO 5	Draft the different views of the model / assembly

Mapping of Course outcomes with program outcomes

Course Outcomes	Program Outcomes									
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO10
CO 1			1		1					
CO 2			1		2					
CO 3			2		3					
CO 4			2		3					
CO 5			2		3					

Course Content

Unit 1: Introduction to Solid Modeling (6 Hrs.)

1.1 Introduction, Applications, Benefits, Need, Hardware Requirements, Different type of High-end cad software's, different modules in the high-end cad software.

1.2 Installation procedure of High-end CAD software's

1.3 Introduction about user interface of high-end CAD software.

Unit 2: Working in 2 D environment (8 Hrs.)

1.1 Working in Sketcher mode – Line, Profile, Circle, Arc, Rectangle and their sub options.

1.2 Constraints - Dimensioning constraint, Geometrical constraint.

1.3 Difference between 2 D and 2 ½ D drawing.

Unit 3: Creation of solid models (8 Hrs.)

3.1 Working in 3 D environment -Creating 3D Solid Models of simple machine parts.

3.2 Intersection of solids – Intersect 2 solid components by inserting new body option, Boolean operations – Union, subtract, intersection.

Unit 4: Assembly Drawing (10 Hrs.)

4.1 Assembly Drawing - Preparation of Assembly drawing by using assembly features. (Assembly of minimum 4-5 components)

4.2 Exploded view – Explode the assembly.

Unit 5: Working in Drafting Mode (10 Hrs.)

5.1 Orthographic projections – Generate orthographic projections which will include all types of views – front view, top view, side view, sectional views, isometric views, auxiliary views.

5.2 Dimensioning Commands – Apply dimensions, dimensional and geometrical tolerances.

5.3 Bill of material – Prepare part list table and name plate

List of Books/References:

1. "AutoCAD 2023 for Beginners" by CADFolks
2. "Mastering AutoCAD 2023 and AutoCAD LT 2023" by George Omura and Brian C. Benton
3. "SolidWorks 2023: A Comprehensive Guide" by Prof. Sham Tickoo
4. "CATIA V5-6R2019 for Designers" by Prof. Sham Tickoo
5. "Introduction to Computer Science using Python" by Charles Dierbach
6. "Computer Fundamentals and Programming in C" by Anita Goel and Ajay Mittal
7. "Computer Proficiency for Everybody" by P.K. Sinha and Priti Sinha

Subject Title: Safety in Engineering Industry Lab

PCC7	BTSFCL406	Safety in Engineering Industry Lab	0-0-2	Credit 1

Teaching Scheme:	**Examination Scheme:**
Practical: 2 Hrs./week	Continuous Assessment: 60 Marks End Semester Exam: 40 Marks

List of Practical's/Experiments/Assignments:

1. Design a machine guard
2. Development of a plant layout
3. Preparation of a safety inspection check list for dock area
4. Prepare a tool box on a good housekeeping
5. List out the hazards in the industries
6. Preparation of housekeeping checklist
7. Development of a SOP for any of a machine
8. List out various safety equipment used in industries
9. Assignments on each unit

Subject Title: Fire Service Equipment & Appliances Lab

PCC8	BTSFCL407	Fire Service Equipment & Appliances Lab	0-0-2	Credit 1

Teaching Scheme:	**Examination Scheme:**
Practical: 2 Hrs./week	Continuous Assessment: 60 Marks End Semester Exam: 40 Marks

List of Practical's/Experiments/Assignments (any 8 experiments from the list)

1. Name the various activities to be carried out while lifting fire hose till target hitting.
2. Draw a stand post pipe with double headed hydrants.
3. Draw suction & delivery hoses with couplings.
4. Name the various commands while conducting 3- man hydrant drills.
5. Name each personnel involved in 3- man hydrant drills.
6. Describe various commands right from starting of fire water to completion of 4- man hydrant drill.
7. State the use of dividing & connecting two-way breaches.
8. Identify the following fire extinguishers & describe safe uses- water expelling type, foam type, DCP type, CO_2 type.
9. Draw & label a neat sketch for 'Dry Chemical Powder' extinguisher with all accessories.
10. Draw & label a neat sketch for 'Carbon dioxide fire' extinguisher with all accessories.
11. Describe inspection, maintenance & testing of various types of fire extinguishers.
12. Name various types of foam branches.
13. Draw & label a neat sketch for various foam making branches.
14. List out various ladders & other equipment's used in fire service for rescue purposes.
15. List out various gears with neat sketch & labeling in fire services for rescue purposes.

Subject: Thermodynamics and Heat Transfer Lab

ESC16	BTESL408	Thermodynamics and Heat Transfer Lab	0-0-2	Credit 1

Teaching Scheme:	**Examination Scheme:**
Practical: 2 Hrs./week	Continuous Assessment: 60 Marks End Semester Exam: 40 Marks

List of experiments:

1. Measurement of dryness fraction of steam using separating & throttling calorimeter
2. Calibration of Thermometers and pressure gauge
3. Joule's experiments to validate first law of thermodynamics.
4. Determination of thermal conductivity of a metal rod.
5. Determination of conductivity of a composite slab
6. Determination of film heat transfer coefficient for natural convection.
7. Determination of film heat transfer coefficient for forced convection
8. Determination of emissivity of a metal surface.
9. Determination of Stefan Boltzmann's constant

Assignment Work

Record of at least six assignments preferably based on latest development in a particular field based on above syllabus.

List of Equipment:

1. Combined separating and throttling Calorimeter apparatus
2. Pneumatic calibrator
3. Joules Experiment apparatus
4. Thermal conductivity of metal rod apparatus
5. Thermal conductivity for composite walls apparatus
6. Free and forced convection apparatus
7. Steafan-boltzman appartus

Subject: CAD and Computer Proficiency

ESC17	BTESL409	CAD and Computer Proficiency Lab	0-0-4	Credit 2

Teaching Scheme:	**Examination Scheme:**
Practical: 4 Hrs./week	Continuous Assessment: 60 Marks End Semester Exam: 40 Marks

List of Practical's:

1. Creation of minimum 4 different 2 D sketches
2. Creation of at least 5 solid models using solid modeling features.
3. Creation of 2 assembly drawings each of at least 5 components.
4. Generation of orthographic projections front view, top view, side view, isometric view.
5. Generation of sectional view.
6. Generation of auxiliary view.
7. Intersection of solids (at least 2 assignments)
8. Plotting of above drawings on A2/A3 size sheet.

Drill-II

LC-2	BTSFD410	Drill-II	0-0-4	Credit 2

Teaching Scheme:	**Examination Scheme:**
4 Hrs./week	Continuous Assessment: 50 Marks

Practical Syllabus based on Standard Drill Manual and Code & Practice

Group A- Squad Drill

Group B- Fire Drill

Books Recommended:

1. Fire Service Manuals U.K.
2. NFPA U.S.A.
3. Drill Manual India

SEMESTER V

Subject Title: Safety in Civil Engineering

PCC9	BTSFC501	Safety in Civil Engineering	3-0-0	Credit 3

Teaching Scheme:	**Examination Scheme:**
Lecture: 3 Hrs./week	Continuous Assessment: 20 Marks Mid Semester Exam: 20 Marks End Semester Exam: 60 Marks (Duration 03 hrs.)

Course Outcomes: After learning the course, the students should be able to

CO 1	Students should able to identify/ suggest ergonomic considerations in construction.
CO 2	Student should able to apply suitable safety measures in various construction operations to make work accident free.
CO 3	Students should able to suggest and apply safety measures in handling various material handling equipments.
CO 4	Students will be able to implement various contract Labor acts and Legal Procedure involved in contracting the labor.
CO 5	Students should able to evaluate all incidents, including near-misses, so management can determine trends and causes, and initiate corrective action
CO 6	Students should be able to give or suggest first aid in emergency.

Mapping of Course outcomes with program outcomes

Course Outcomes	Program Outcomes									
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO10
CO 1		2	2			1			2	1
CO 2				2				1	2	2
CO 3	2	3	2				3		1	2
CO 4	2	2	2						1	2
CO 5	2	3	2		2			1	1	2
CO 6						2			1	1

All units carry 12 Marks each for End Semester Examination.

COURSE CONTENTS:

Unit 1: Introduction (08 Hrs.)

Introduction to Construction Industry- Safety issues in construction- Human factors in construction safety management. Roles of various groups in ensuring safety in construction industry. Framing Contract conditions on safety, and related matters. Relevance of ergonomics in construction safety.

Unit 2: Safety in various construction operations (08 Hrs.)

Safety in various construction operations- Excavation- under- water works- under- pinning & shoring Ladders & Scaffolds- Tunneling- Blasting- Demolition- Pneumatic caissons- confined Space Temporary Structures. Indian Standards on construction safety- National Building Code Provisions on construction safety.

Unit 3: Safety in material handling (04 Hrs.)

Safety in material handling and equipments-Safety in storage & stacking of construction materials.

Unit 4: Safety of construction equipments (06 Hrs.)

Safety in these of construction equipments- Vehicles, Cranes, Tower Cranes, Lifting gears, Hoists & Lifts, Wire Ropes, Pulley blocks, Mixers, Conveyors, Pneumatic and hydraulic tools in construction. Temporary power supply.

Unit 5: Contract Labor (R&A) Act and Central Rules (12 Hrs.)

Contract Labor (R&A) Act and Central Rules: Definitions, Registration of Establishments, Licensing of Contractors, Welfare and Health provisions in the Act and the Rules, Penalties, Rules regarding wages. Building & Other Construction Workers (RE&CS) Act,1996 and Central Rules, 1998: Applicability, Administration, Registration, Welfare Board & Welfare Fund, Training of Building workers, General Safety, Health & Well fare provisions, Penalties.

Learning Recourses:

Books:

Sr No	Author	Title
1	K.N. Vaid	Construction Safety Management
2	V.J. Davies And K. Tomasin	Construction Safety Handbook.

3	James B.Fullman	Construction Safety, Security & Loss Prevention
4	R.T. Ratay	Hand book of Temporary Structures in Construction.
5	National Building Code of India	National Building Code of India

Subject Title: Fire Prevention and Rescue

PCC10	BTSFC502	Fire Prevention and Rescue	2-0-0	Credit 2

Teaching Scheme:	**Examination Scheme:**
Lecture: 3 hrs./week	Continuous Assessment: 20 Marks Mid Semester Exam: 20 Marks End Semester Exam: 60 Marks (Duration 03 hrs.)

Course Outcomes: At the end of the course, students will be able to

CO 1	Identify the causes of fire
CO 2	Select proper protection facilities
CO 3	List prevention activities
CO 4	Label instructions and safety signs
CO 5	Diagnose the faults in the system
CO 6	Implement rules and regulation of fire prevention

Mapping of Course outcomes with program outcomes

Course Outcomes	Program Outcomes									
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO10
CO 1	1	3		3						
CO 2		1	3		3	1				
CO 3					1	3	3		2	
CO 4	3		1			3				
CO 5		2		3	3					
CO6						2		3		

All units carry 10 Marks each for End Semester Examination.

Course Contents:

Unit 1 Fire Prevention and Protection: (14 Hrs.)
Organization for fire prevention, inspection enforcement of codes, public education and community relation, Fire loading, Access for firefighting, causes of fire and their preventive methods General fire prevention measures, and housekeeping, Standing fire orders, fire practice and mutual aid scheme, Fire Prevention and Protection for flammable Gas and Liquid plants,

Unit 2Escape from fire: (10 Hrs.)
Fire protection, fire prevention and its importance, means of escape in case of fire, fire separation and compartmentation, fire notices, provision and siting of first aid firefighting equipment's, ventilation systems including fire and smoke venting.

Unit 3 Chemical Leak: (10 Hrs.)
Prevention and protective measures to be taken in case of Gas/ Liquid leak from Chlorine tonner, LPG tanker, Ammonia container.

Unit 4 Storage of Hazardous Material: (10 Hrs.)
Storage of hazardous materials: Warehouse and its requirements, Ventilation, entrance and exits, Types of storages and various methods of stacking of goods, Firefighting arrangements and action in case of fire as per rules, Factors involved in fire risk, standard basis, Fuel storage and gas cylinders.

Unit 5 Salvage: (10 Hrs.)
Damage due to fire, smoke and water, Equipment for salvage work, salvage covers, forced entrance, salvage works, Packing and Storing, Salvage before entering fire ground, after entering fire ground, Salvage following fire ground, saving property.

Learning Resources:

1. **Books**

Sr No	Author	Title	Publications
1	BIS	NBC-Part IV	---

2	JJ Williams	General Fire Hazards and Fire Protection	---
3	Kesteren Fire Brigade	Fire Prevention Notes for Industrial Premises	NFPA
4	NFPA	Fire Prevention Hand Book	NFPA
5	Enrnest Beam Ltd.	Fire Prevention Standard Recommendations	---
6	Nilesh B. Ukunde	Early Warning Smoke Detection cum Fire Alarm System	---
7	---	Hand book of Fire Protection	NFPA
8	Warre J Baker	Automation – A Challenge to Fire Protection Engineers	---
9	Mather and Platt.	Fire Protection- Technical Information and Useful General Knowledge	---
10	HMSO	Fire protection in Factory Buildings	HMSO
11	Crosby-Fiske	Forster Hand Book of Fire Protection.	
12	Danna and Milne	Industrial Fire Hazzards	
13	Rof Jensen	Fire protection for the design professional	
14	Willium K. Bare	Introduction to Fire science and Fire protection	
15	Bryan	Fire Suppression and Detection System	

2. IS/ INTERNATIONAL CODES/ WEBSITES:

IS 6382:1984 Code of practice for design and installation of fixed carbon dioxide fire extinguishingsystem. (1st Revision)

IS 15105-2002 Design and installation of fixed automatic sprinkler fire extinguishing

System

- National Fire Protection Association (NFPA) website: Provides access to fire codes, standards, research reports, and educational resources.
- Occupational Safety and Health Administration (OSHA) website: Offers guidance on workplace fire safety and regulations.
- Firehouse.com: Online platform with articles, news, and resources related to firefighting and fire safety.
- International Association of Fire Chiefs (IAFC) website: Provides resources and publications on fire prevention and leadership in the fire service.

Subject Title: Disaster Management

PCC11	BTSFC503	Disaster Management	3-0-0	Credit 3

Teaching Scheme:	**Examination Scheme:**
Lecture: 3 Hrs./week	Continuous Assessment: 20 Marks Mid Semester Exam: 20 Marks End Semester Exam: 60 Marks (Duration 03 hrs.)

Course Outcomes: After learning the course, students should able to

CO1	To provide basic conceptual understanding of disasters.
CO2	To know approaches of disaster management
CO3	To build skills to respond to disaster
CO4	To Realize disasters, disaster preparedness and apply the mitigation measures
CO5	To Recognize role of IT, remote sensing, GIS and GPS in risk reduction
CO6	Apply knowledge of disaster management acts and guidelines.
CO6	To build to respond in disaster condition

Mapping of course outcomes with program outcomes:

Course outcomes	Programme outcomes						
	PO1	PO2	PO3	PO4	PO5	PO6	PO7
CO1			2		2		
CO2			2				
CO3			2	3	2		
CO4			2	3			
CO5			2				
CO6			3	3	2	2	2
CO7				2	2	1	

All units carry 10 Marks each for End Semester Examination.

Unit 1: Definition and types of disaster (12 Hrs)

Hazards and Disasters, Risk and Vulnerability in Disasters, Natural and Man-made disasters, earthquakes, floods drought, landside, land subsidence, cyclones, volcanoes, tsunami, avalanches, global climate extremes. Man-made disasters: Terrorism, gas and radiations leaks, toxic waste disposal, oil spills, forest fires.

Unit 2: Study of Important disasters (12Hrs)

Earthquakes and its types, magnitude and intensity, seismic zones of India, major fault systems of India plate, flood types and its management, drought types and its management, landside and its managements Social Economics and Environmental impact of disasters. Earthquakes and its types, magnitude and intensity, seismic zones of India, major fault systems of India plate, flood types and its management, drought types and its management, landside and its managements

Unit 3: Mitigation and Management techniques of Disaster (8 Hrs)

Basic principles of disasters management, Disaster Management cycle, Disaster management policy, National and State Bodies for Disaster Management, Early Warming Systems, Building design and construction in highly seismic zones, retrofitting of buildings.

Unit 4: Training, awareness program and project on disaster management (8 Hrs)

Training and drills for disaster preparedness, Awareness generation program, Usages of GIS and Remote sensing techniques in disaster management, Mini project on disaster risk assessment and preparedness for disasters with reference to disasters in Sikkim and its surrounding areas.

Unit 5: Natural Disasters (8 Hrs)

Natural Disasters Natural Disasters- Meaning and nature of natural disasters, their type and effects; Hydrological Disasters Flood, flash flood, Drought, cloud burst; Geological Disasters- Earthquake, Tsunamis, Landslides, Avalanches, Volcanic eruption and mudflow

Reference/ Text Books:

1. Disaster Management Guidelines, GOI-UND Disaster Risk Program (2009-2012) 2.Damon, P. Copola, (2006) Introduction to International Disaster Management, Butterworth Heineman.

3.Gupta A.K., Niar S.S and Chatterjee S. (2013) Disaster management and Risk Reduction, Role of Environmental Knowledge, Narosa Publishing House, Delhi.

4. Murthy D.B.N. (2012) Disaster Management, Deep and Deep Publication PVT. Ltd. New Delhi.

5. Modh S. (2010) Managing Natural Disasters, Mac Millan publishers India LTD.

Subject Title: First Aid and occupational health

PEC2	BTSFPE504A	First Aid and occupational health	3-0-0	Credit 3

Teaching Scheme:	**Examination Scheme:**
Lecture: 3 Hrs./week	Continuous Assessment: 20 Marks Mid Semester Exam: 20 Marks End Semester Exam: 60 Marks (Duration 03 hrs.)

Course Outcomes: After learning the course, the students should be able to

CO 1	To give first aid in the medical emergency before shifting to Hospital.
CO 2	Learn all step that need to take prior to delivering care during medical emergency
CO 3	Recognize normal function of human body
CO 4	Take proper action when body is not functioning properly
CO 5	Manage different emergency situation in Adult, children, Infant
CO 6	Save life of victim by using First Aid technique

Mapping of Course outcomes with program outcomes

Course Outcomes	Program Outcomes									
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO10
CO 1			2		2					2
CO 2			2							2
CO 3			2	3	2				1	2
CO 4			2	3					1	2
CO 5			2						1	2
CO 6			3	3	2	2	2		1	1

Unit 1- 4 10 Marks each and 5- 8 5 marks each for End Semester Examination.

COURSE CONTENTS:

Unit 1: Introduction to human vital organ Normal Parameter

1.1 Heart, kidney, lung. Brain, liver (In brief) Norman Functioning

1.2 Body Normal Parameter for Assessment of Pulse rare, heart rate, heart sound Breathing rate, sound, vital capacity, temperature of body. O2 saturation

Unit 2: Concept of First Definition Quality of First Aid Provider

2.1 Objective & Advantage of First Aid
2.2 Ten Basic procedure of First Aid
2.3 Five rules (A B C D E) of First Aid

Unit 3: Types of Accident / medical emergency

3.1 Physical Injury
3.2 Mechanical Injury
3.3 Chemical Injury
3.4 Biological Injury
3.5 Poisoning
3.6 Drowning
3.7 Airway obstruction
3.8 Fire Accident

Unit 4: Methods of First Aid for different Emergency

4.1 CPR (Cardiopulmonary resuscitation)

First Aid for

1. Cardiac Arrest·
2. Mouth to Mouth Respiration
3. First Aid for Burn.
4. First Aid for unconsciousness

Unit 5: **Bandages & Different Material of First Aid Box**

5.1 Acting in Emergency
5.2 Automated External Defibrillator
5.3 controlling Bleeding

Learning Recourses:

Books:

Sr No	**Author**	**Title**	**Publisher**
1	Andrew K. Marsden	First Aid Manual of WHO	WHO

2	Jason Hunt	Bush craft First Aid	Care Dave Cantbury Publication
3	Barbara cleaver, Rudy Crawford, Viven J. Armstrong	First Aid Manual	St Jhon Ambulance
4	James Hobbard	Living Ready Pocket Manual	F&W Publication
5	Friedrich Esmarch	Red cross First Aid Book	Red Cross Society

Subject Title: Mechanical Measurement & Control

PEC2	BTSFPE504B	Mechanical Measurement & Control	3-0-0	Credit 3

Teaching Scheme:	**Examination Scheme:**
Lecture: 3 Hrs./week	Continuous Assessment: 20 Marks Mid Semester Exam: 20 Marks End Semester Exam: 60 Marks (Duration 03 hrs.)

Course Outcomes: After learning the course, the students should be able to

CO 1	Understand the basics of measurements and the importance of accuracy and standards.
CO 2	Identify and minimize errors in measurements.
CO 3	Understand the principles of measurement of displacement, velocity, acceleration, force, pressure, flow rate and temperature.
CO 4	select the appropriate measurement method for a given application
CO 5	calibrate and maintain measurement instrument

Mapping of Course outcomes with program outcomes

Course Outcomes	Program Outcomes									
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO10
CO 1	1				2				2	
CO 2			3				2			
CO 3			2							
CO 4										
CO 5	1				2					

Unit 1 Measurement: Measurement of displacement, velocity, acceleration and vibrations, by potentiometer, strain gauges, seismic pickups, velocity pickups and acceleration pickups, calibration of pickups. **(8 Hrs)**

Unit 2 Force Measurement: Torque and shaft power measurement, Basic method of force measurements, elastic force transducers, torque measurement on rotating shaft, shaft power measurement. **(8 Hrs)**

Unit 3 Pressure Measurement: Comparative study of different types of manometers, sensitivity of manometers, comparison of water, mercury and oil as a manometric fluid, Air micro manometers, sonar manometers, low pressure gauges such as McLeod gauge, Thermal

conductivity gauge, Pirani gauge, Ionization Gauge, Piezo-electric pressure transducers, Elastic Transducers, Force balance Transducers. Dead weight gauges, elastic transducers and force balance transducer. **(12 Hrs)**

Unit 4 Flow Measurement : Gross flow rate measuring meters, constants area, variable pressure drop meters (obstruction meters), local flow velocity magnitude and direction meters, Hot-wire anemometer **(10 Hrs)**

Unit 5 Temperature Measurement: Measurement of temperature by liquid - in - glass thermometers, pressure thermometers, thermocouples, their calibration, resistance thermometer, Bimetallic thermometer, thermistors, radiation and optical pyrometers. **(10 Hrs)**

List of Books/References:

1. "Engineering Metrology and Measurements" by Raghavendra, Krishnamurthy, and Venkata Reddy
2. "Mechanical Measurements" by Thomas G. Beckwith, Roy D. Marangoni, and John H. Lienhard V
3. "Metrology and Measurements" by N. Krishnamurthy
4. "Instrumentation and Measurement in Electrical Engineering" by Roman Malaric
5. "Mechanical Measurements" by P. G. H. Eschenbach
6. "Engineering Metrology" by I.C. Gupta
7. "Mechanical and Industrial Measurements" by R. K. Jain, A. K. Choudhary, and N. K. Jain
8. "Introduction to Instrumentation and Measurements" by Robert B. Northrop
9. "Industrial Instrumentation and Control" by S. K. Singh
10. "Metrology, Quality Control and Reliability" by D. P. Sahu and S. Choudhury

Subject Title: Artificial Intelligence

PEC2	BTSFPE504C	Artificial Intelligence	3-0-0	Credit 3

Teaching Scheme:	**Examination Scheme:**
Lecture: 3 Hrs./week	Continuous Assessment: 20 Marks Mid Semester Exam: 20 Marks End Semester Exam: 60 Marks (Duration 03 hrs.)

Course Outcomes: After learning the course, the students should be able to

CO 1	Understand the basics of Artificial Intelligence and its historical development.
CO 2	Learn problem-solving techniques using search algorithms and heuristics.
CO 3	Apply logical reasoning and knowledge representation methods in AI.
CO 4	Design intelligent agents capable of planning and acting in uncertain environments.
CO 5	Explore various learning algorithms, including decision trees, neural networks, and reinforcement learning
CO 6	Develop practical applications in natural language processing, image processing, and robotics.

Mapping of Course outcomes with program outcomes

Course Outcomes	Program Outcomes									
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO10
CO 1	3			2						1
CO 2			2							
CO 3							3			
CO 4		2							2	
CO 5					2				2	
CO 6				2						2

All units carry 10 Marks each for End Semester Examination.

Course Content:

Unit I: (7Hrs.)

Artificial Intelligence:

Introduction – What is AI? The Foundations of Artificial Intelligence, the History of Artificial Intelligence, the State of The Art. Intelligent Agents – Introduction, How Agents should act, Structure of Intelligent Agents, Environments.

Unit II: (7Hrs.)

Knowledge and reasoning: Agents that Reason Logically – A Knowledge-Based Agent, the Wumpus World Environment, Representation, Reasoning and Logic, Propositional Logic, First Order Logic – Syntax and Semantics, Extensions and Notational Variations, Using First-Order Logic, Logical Agents for Wumpus World, , General Ontology, the Grocery Shopping World.

Unit III: (8 Hrs.)

Acting logically: Planning – A Simple Planning Agent, From Problem Solving to Planning, Planning in Situation Calculus, Basic Representations for Planning, A Partial- Order Planning Example & Algorithm, Planning with Partially Instantiated Operators, Knowledge Engineering for Planning.

Unit IV: (7 Hrs.)

Uncertain Knowledge and reasoning: Uncertainty – Acting under Uncertainty, Basic Probability Notation, the Axioms of Probability, Bayes' Rule and Its Use. Probabilities Reasoning systems – Representing Knowledge in an Uncertain Domain, The Semantics of Belief Networks, Inference in Belief Networks, Inference in Multiply Connected Belief Networks.

Unit V: (8 Hrs.)

Learning:

Learning from Observations – A General Model of Learning Agents, Inductive Learning, and Learning Decision Trees, Using Information Theory, Learning General Logical Descriptions, and Computational Learning Theory. Learning in Neural and Belief Networks – How the Brain Works, Neural Networks, Perceptions, Multilayer Feed-forward Networks, Applications of Neural Networks,

Books Recommended:

1) Artificial Intelligence A Modern Approach – By Stuart J. Russell and Peter Norvig, John F. Canny, Jitendra M. Malik, Douglas D.

2) Artificial Intelligence for Dummies by John Mueller

3) Artificial Intelligence Basics: A Non-Technical Introduction by Tom Taull

Subject Title: Piping Design

OEC1	BTSFOE505A	Piping Design	3-0-0	Credit 3

Teaching Scheme:	**Examination Scheme:**
Lecture: 3 Hrs./week	Continuous Assessment: 20 Marks Mid Semester Exam: 20 Marks End Semester Exam: 60 Marks (Duration 03 hrs.)

Course Outcomes: After learning the course, the students should be able to

CO 1	Recognize the purpose of piping and its use along with the classifications and design consideration involved.
CO 2	Design pipe laying, jointing and testing of pressure and non-pressure pipe.
CO 3	Analyze water hammer pressure and select appropriate surge protection devices.
CO 4	Design rising main, find out optimal diameter and power requirement
CO 5	Understand Rehabilitation of pipeline, need of water audit and control system for distribution system.
CO 6	Understand purpose and operation of the system before detailed designing.

Mapping of Course outcomes with program outcomes

Course Outcomes	Program Outcomes									
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO10
CO 1	2		2		2					2
CO 2			2	3		2	1			2
CO 3	1	2	2	3	2				1	2
CO 4			2	3					1	2
CO 5	2		2			2	2	1	1	2
CO 6				3	2	2	2		1	1

All units carry 10 Marks each for End Semester Examination.

COURSE CONTENTS:

Unit 1: Introduction - Overview of Piping (08 Hrs.)

1.1 Purpose of piping
1.2 Types of piping and support classifications;
1.3Project planning
1.4Modes of failure: stress types, fracture types and fatigue; Stress theories; principle and shear
1.5Applicable codes and standards: ASME; MSS; and Misc. codes

Unit 2: Piping Components and the Total System (08 Hrs.)

2.1 Piping system components and process types
2.2 Piping & fittings: characteristics, size and selection, calculations and considerations
2.3Valves: types, functions, operation and control of valves
2.4Design and applications of tanks and pressure vessels
2.5Pipe size criteria
2.6Troubleshooting

Unit 3: Pipe Layout, Joint system and Testing (08 Hrs.)

3.1 System test pressure, Excavation, bedding, lowering and handling of pipes
3.2 Types of joints
3.3 Testing of Pressure Pipes and Non pressure pipes.
3.4 Testing of welded joints by Nondestructive testing methods

Unit 4: Pressure Transient (08 Hrs.)

4.1 Water hammer
4.2 Surge analysis, surge pressure and its calculation
4.3 Remedial measures for water hammer and devices used to control water hammer
4.4 Use of Thrust block.

Unit 5: Rehabilitation and Water Auditing (08 Hrs.)

5.1 Rehabilitation of pipeline
5.2 Water audit
5.3 Online monitoring and control system
5.4 Leak detection in pipeline, burst detection techniques

Learning Recourses:

1. Analysis of Water Distribution Network by P. R. Bhave and R. Gupta
2. Water supply and sanitary engineering by G.S.Birdie and J.S.Birdie
3. Environmental engineering by H.S. Peavy, D.R.Row&G.Tchobanoglous
4. Pipe and Pipelines by JAICO publishers
5. CPHEEO Manual on water supply and treatment
6. IWWA Manual on Design and Selection of pipes for water supply
7. ASME section IX
8. API 1104
9. IS 3589 latest edition
10. IS 5504 latest edition

Subject Title: Robotics and Automation

OEC1	BTSFOE505B	Robotics and Automation	3-0-0	Credit 3

Teaching Scheme:	**Examination Scheme:**
Lecture: 3 Hrs./week	Continuous Assessment: 20 Marks Mid Semester Exam: 20 Marks End Semester Exam: 60 Marks (Duration 03 hrs.)

Course Outcomes: After learning the course, the students should be able to

CO 1	Identify anatomy, specifications and types of Robots
CO 2	Obtain forward and inverse kinematic models of robotic manipulators
CO 3	Develop dynamic model and design the controller for robotic manipulators
CO 4	Control the motion and sensors of the robot.
CO 5	To carry out programming using PLC and use of various PLCs to Automation problems in industries
CO 6	To discuss supervisory control and data acquisition method and use the same in complex automation areas

Mapping of Course outcomes with program outcomes

Course Outcomes	Program Outcomes									
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO10
CO 1	3			1					2	
CO 2	3									2
CO 3	2		1						2	
CO 4	3					2				
CO 5	3									2
CO 6	3									

All units carry 10 Marks each for End Semester Examination.

COURSE CONTENTS:

Unit 1: Introduction (10 Hrs.) -

Definitions- Robots, Robotics; Types of Robots- Manipulators, Mobile Robots-wheeled & Legged Robots, Aerial Robots; Anatomy of a robotic manipulator-links, joints, actuators, sensors, controller; open kinematic vs closed kinematic chain; degrees of freedom;

Unit 2 – Robot Configuration- (08 Hrs)

Robot configurations-PPP, RPP, RRP, RRR; features of SCARA, PUMA Robots; Classification of robots based on motion control methods and drive technologies; 3R concurrent wrist; Classification of End effectors - mechanical grippers, special tools, Magnetic grippers, Vacuum grippers, adhesive grippers, Active and passive grippers, selection and design considerations of grippers in robot.

Unit 3: Robot Kinematics (12 Hrs.)

Direct Kinematics- Rotations-Fundamental and composite Rotations, Homogeneous coordinates, Translations and rotations, Composite homogeneous transformations, Screw transformations, Kinematic parameters, The Denavit-Hartenberg (D-H) representation, The arm equation, direct kinematics problems (upto 3DOF) Inverse kinematics- general properties of solutions, Problems (upto 3DOF) Inverse kinematics of 3DOF manipulator with concurrent wrist (demo/assignment only) Tool configuration Jacobian, relation between joint and end effector velocities.

Unit 4: Manipulator Dynamics (12 Hrs.)

Lagrange's formulation – Kinetic Energy expression, velocity Jacobian and Potential Energy expression, Generalised force, Euler-Lagrange equation, Dynamic model of planar and spatial serial robots upto 2 DOF, modelling including motor and gearbox. Unit 4: Safety of construction equipments (06 Hrs.)

Unit 5: Robot Control (06 Hrs.)

The control problem, Single axis PID control-its disadvantages, PD gravity control, computed torque control. Simulation of simple robot-control system-Matlab programming for control of robots(demonstration/assignment only)

Learning Recourses:

Books:

Sr No	Title and Publication	Author
1	"Fundamentals of robotics – Analysis and control", Prentice Hall of India 1996.	Robert. J. Schilling ,
2	Introduction to Robotics	(Mechanics and control), John. J. Craig, Pearson Education Asia 2002.
3	Introduction to Robotics	S K Saha, Mc Graw Hill Education

4	"Robotics and Control",	R K Mittal and I J Nagrath, Tata McGraw Hill, New Delhi,2003.
5	Programmable Logic Controllers	by W.Bolton
6	Process Control Instrumentation Technology,	Johnson Curties, Prentice hall of India, 8th edition

Subject Title: Internet of Things

OEC1	BTSFOE505C	Internet of Things	3-0-0	Credit 3

Teaching Scheme:	**Examination Scheme:**
Lecture: 3 Hrs./week	Continuous Assessment: 20 Marks Mid Semester Exam: 20 Marks End Semester Exam: 60 Marks (Duration 03 hrs.)

Course Outcomes: After learning the course, the students should be able to

CO 1	Demonstrate basic concepts, principles and challenges in IoT.
CO 2	Illustrate functioning of hardware devices and sensors used for IoT.
CO 3	Analyze network communication aspects and protocols used in IoT.
CO 4	Apply IoT for developing real life applications using Ardunio programming.
CO 5	develop IoT infrastructure for popular applications

Mapping of Course outcomes with program outcomes

Course Outcomes	Program Outcomes									
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO10
CO 1	3					3				3
CO 2	3		2		2					
CO 3	3	2			2					
CO 4	3		3	2						
CO 5	3		3				2			

All units carry 12 Marks each for End Semester Examination.

COURSE CONTENTS:

Unit 1: IOT Fundamentals (06 Hrs.)

Internet of Things (IoT): Vision, Definition, Conceptual Framework, Architectural view, technology behind IoT, Sources of the IoT, M2M Communication, IoT Examples. Design Principles for Connected Devices: IoT/M2M systems layers and design standardization, communication technologies, data enrichment and consolidation, ease of designing and affordability

Unit 2: Hardware for IOT (08 Hrs.)

Sensors, Digital sensors, actuators, radio frequency identification (RFID) technology, wireless sensor networks, participatory sensing technology. Embedded Platforms for IoT: Embedded computing basics, Overview of IOT supported Hardware platforms such as Arduino, Net Arduino, Raspberry pi, Beagle Bone, Intel Galileo boards and ARM cortex

Unit 3: Network and Communication aspects of IOT (08 Hrs.)

Wireless Medium access issues, MAC protocol survey, Survey routing protocols, Sensor deployment & Node discovery, Data aggregation & dissemination

Unit 4: Ardunio Programming (08 Hrs.)

Ardunio Platform Boards Anatomy, Ardunio IDE, coding, using emulator, using libraries, additions in ardunio, programming the ardunio for IoT.

Unit 5: IOT Design Aspects (10 Hrs.)

Development Challenges, Security Challenges, Other challenges IoT Applications: Smart Metering, E-health, City Automation, Automotive Applications, home automation, smart cards, communicating data with H/W units, mobiles, tablets, Designing of smart street lights in smart city

Learning Recourses:

Books:

Sr No	Title and Publication	Author
1	"The Internet of Things key applications and protocols", willey	Olivier Hersent, David Boswarthick, Omar Elloumi
2	Internet of Things, Khanna Publishing House	Jeeva Jose.
3	"The Internet of Things" by Pearson	Michael Miller
4	"INTERNET OF THINGS", McGraw-Hill, 1ST Edition, 2016	Raj Kamal
5	"Designing the Internet of Things" Wiley India	Adrian McEwen,Hakin Cassimally
6	"Internet of Things (A hands on approach)" 1ST edition, VPI publications,2014	Arshdeep Bahga, Vijay Madisetti

Subject Title: Safety in Civil Engineering Lab

PCC12	BTSFCL506	Safety in Civil Engineering Lab	0-0-2	Credit 1

Teaching Scheme:	**Examination Scheme:**
Practical: 2 Hrs./week	Continuous Assessment: 60 Marks End Semester Exam: 40 Marks

List of Practical's/Experiments/Assignments (any 8 experiments from the list)

1. To determine Safety and health rules and regulations.
2. To determine Supervisory safety performance evaluation
3. To Job safety analysis.
4. To determine Accident and incident investigation
5. To determine Hazard communication standard
6. To determine Confined space entry
7. To study Hearing conservation
8. To determine Personal protective equipment
9. Determine Fall protection
10. To determine Ergonomics in construction.
11. To study Excavation
12. Determine First aid and medical attention

List of Instrument/Apparatus:

1. Safety Helmets Or Hard Hats
2. Safety Shoes
3. Ear Muffs Or Ear Plugs
4. Safety Goggles
5. Safety Gloves
6. Personal Protective Equipment

Subject Title: Fire Prevention and Rescue Lab

PCC13	BTSFCL507	Fire Prevention and Rescue Lab	0-0-4	Credit 2

Teaching Scheme:	**Examination Scheme:**
Lecture: 4 hrs./week	Continuous Assessment: 60 Marks End Semester Exam: 40 Marks

List of Practical's/Experiments/Assignments (any ten experiments from the list)

1. Conducting fire inspections in various settings, such as residential buildings, commercial establishments, and industrial facilities.
2. Analyzing the causes of fires and developing preventive methods and measures.
3. Conducting practical exercises on general fire prevention measures and maintaining proper housekeeping to reduce fire risks.
4. Assessing the fire protection measures in buildings and identifying means of escape in case of fire.
5. Practicing techniques for effective fire separation and compartmentation within structures. Installing fire notices and signage in appropriate locations.
6. Practicing emergency response and protective measures in case of chemical leaks, including containment, evacuation, and communication protocols.
7. Conducting assessments of warehouses and their compliance with safety requirements for storing hazardous materials.
8. Analyzing the factors involved in fire risk and establishing standard safety protocols for fuel storage and gas cylinders.
9. Simulating scenarios of damage caused by fire, smoke, and water, and implementing salvage operations.
10. Practicing the use of equipment and materials for salvage work, such as salvage covers and forced entry tools.
11. Conducting exercises on packing, storing, and salvaging property before, during, and after fire fighting operations.

12. Demonstrating different rescue techniques, such as lift rescue, hydraulic platform rescue, and rescue from sewers, roads, railways, and highways.
13. Simulating scenarios of rescue operations in collapsed buildings and conducting practical exercises on search and extraction techniques.
14. Practicing rescue operations involving animals, debris, wells, rivers, trains, and aircraft accidents.

Subject Title: Disaster Management Lab

PCC14	BTSFCL509	Disaster Management Lab	0-0-2	Credit 1

Teaching Scheme:	**Examination Scheme:**
Practical: 2 Hrs./week	Continuous Assessment: 60 Marks End Semester Exam: 40 Marks

List of assignment:

1. Student should list down dos and do not's at individual or household levels (before, during and after a disaster).
2. Student should write down communication, coordination, Cooperation during the emergencies
3. Student should do case study on Community Based First Aid (CBFA)
4. Student should do case study on Community Based Disaster Management (CBDM)
5. Student should do case study on Mock drills (Fire, Earthquake, Campus Shooting, Bomb Threat)
6. Student should do case study on Risk identification; Application of Remote Sensing (RS)
7. Student should list down application for Geographic Information System (GIS)
8. Student should list down application for Global Positioning System (GPS) in Risk Assessment

Subject Title: Drill - III

LC3	BTSFD510	Drill - III	0-0-4	Credit 2

Teaching Scheme:	**Examination Scheme:**
Lecture: 4 hrs./week	Continuous Assessment: 50 Marks

Practical syllabus based on Standard Drill Manual and Code & Practice.

Group A – Squad Drill

Group B – Fire Drill.

Books Recommended:

1. Fire Service Manual U. K.
2. NFPA U. S. A.
3. Drill Manual India

SEMESTER VI

Subject Title: Chemical & Process Safety Management

PCC15	BTSFC601	Chemical & Process Safety Management	3-0-0	Credit 3

Teaching Scheme:	**Examination Scheme:**
Lecture: 3 Hrs./week	Continuous Assessment: 20 Marks Mid Semester Exam: 20 Marks End Semester Exam: 60 Marks (Duration 03 hrs.)

Course Outcomes: After learning the course, the students should be able to-

CO 1	Differentiate between inherent safety and engineered safety and recognize the importance of safety in the design of chemical process plants.
CO 2	Develop thorough knowledge about safety in the operation of chemical plants.
CO 3	Apply the principles of safety in the storage and handling of gases.
CO 4	Identify the conditions that lead to reaction hazards and adopt measures to prevent them.
CO 5	Able to choose the proper type of first aid and portable fire protection system appropriate to the given situation.

Mapping of Course outcomes with program outcomes

Course Outcomes	Program Outcomes									
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO10
CO 1	2	1		1		2	2		1	2
CO 2	2		2							2
CO 3	2						2			2
CO 4		2		3			2		1	2
CO 5		2	2		2				1	2

All units carry 12 Marks each for End Semester Examination.

COURSE CONTENTS:

Unit I Safety in the Design of Chemical Process Plants: (10 Hrs.)

Design principles- Process design development, types of designs, feasibility survey, preliminary design, flow diagrams, piping and instrumentation diagram, Equipment specifications- Reliability and safety in designing, Inherent safety, engineered safety, safety during start up and shutdown. Safety checks in the design of the equipment's- Reactor safety, safety in erection and commissioning of chemical plants. Nondestructive testing methods- Pressure and leak testing, emergency safety

devices, scrubbers and flares. New concepts in safety design and operation- Pressure vessel testing standards, Inspection techniques for boilers and reaction vessels.

Unit II Safety in Chemical Process Plants While Operations: (8 Hrs)
Properties of chemicals- Material Safety Data Sheets, Various properties and formats used, Methods available for property determination. Operational activities and hazards- Standards operating procedures, safe operation of pumps, compressors, heaters, column, reactors, pressure vessels, storage vessels. Piping systems- Effects of pressure, temperature, flow rate and humidity on operations. Corrosion and control measures-Condition monitoring, control valves, safety valves, pressure reducing valves, drains, bypass valves, inert gases. Chemical splashes, eye irrigation and automatic showers.

Unit III Safety in the Storage and Handling of Chemical Sand Gases: (8Hrs)
Types of storage, General considerations for storage layouts, atmospheric venting, pressure and temperature relief, relief valve sizing calculations, storage and handling of hazardous chemicals and industrial gases, safe disposal methods, reaction with other chemicals, hazards during transportation, pipe line transport, safety in chemical laboratories. Safety provisions like level and flow indicators, alarms, trips, protection of stills, columns and towers from lightening, colour coding for pipelines and cylinders.

Unit IV Chemical Reaction Hazards: (12 Hrs)
Hazardous inorganic and organic reactions and processes, Reactivity as a process hazard, Detonations, Deflagrations, and Runaways, Assessment and Testing strategies, Self-heating hazards of solids, Classification of materials with explosive potential, Hazard prediction by thermodynamic calculations, Prevention and control of explosions and detonations diluting are lease, purging and inserting, venting, explosion relief, flame arrestors, explosion suppression, Classification of hazardous areas.

Unit V Principles of Fire Extinguishments- (12Hrs)
Extinction of premixed flames, diffusion flames and burning metals, fire triangle, fire tetrahedron. Basic concept- Firefighting with water, carbon dioxide, powders, foams, inert gases halon. Need for halon replacement and halon substitutes- flame extinguishing concentration, inserting concentration, fire trials. First aid fire protection-fire bucket, sand bucket, fire blanket, hose reels. Description, working principle, method of operationof different types of portable fire extinguishers- Care, inspection, and maintenance of portable extinguishers as per relevant Indian standards specifications.

Learning Recourses:
Books:

Sr No	Author	Title
1	Ernest E. Ludwig	Applied Process Design

2	Gavin Towler	Chemical Engg Design
3	Daniel A. Crowl	Chemical Process safety
4	Willey	Implementing Process Safety Management
5	Pro. M N Vyas	Safety & Hazard management in Chemical Industries
6	Alfred Nobel	Process safety Management

Subject Title: Fire Detection and Installation Fire Fighting System-I

PCC16	BTSFC602	Fire Detection and Installation Fire Fighting System-I	2-0-0	Credit 2

Teaching Scheme:	**Examination Scheme:**
Lecture: 3 Hrs./week	Continuous Assessment: 20 Marks Mid Semester Exam: 20 Marks End Semester Exam: 60 Marks (Duration 03 hrs.)

Course Outcomes: At the end of the course, students will be able to

CO 1	Understand provisions, standards, and cost analysis of detection and alarm systems, and fire suppression systems using foam, gases, and dry chemical powder
CO 2	Identify and select appropriate detection devices and alarm systems.
CO 3	Analyze and execute the design, installation, testing, and commissioning of detection and alarm systems.
CO 4	Understand the classification, properties, and design considerations of fire suppression systems using foam, gases, and dry chemical powder.
CO 5	Design foam systems based on hazard classification, foam agent selection, and required water/foam quantities

Mapping of Course outcomes with program outcomes

Course Outcomes	Program Outcomes									
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO10
CO 1	3				2		2			
CO 2		3		1					2	
CO 3		2	3	2					2	
CO 4	2					3	2			
CO 5	3		3		2		2			

All units carry 12 Marks each for End Semester Examination.

Course Contents:

Unit 1: Provisions & applicable standards of detection and alarm system (10 Hrs.)
Introduction of detection devices, alarm and detection system, Type of detectors, Method of selection. Cost analysis, design, installation, testing and commissioning of alarm and detection system. Provisions & applicable standards of foam, gases and dry chemical powder based systems.

Unit 2: Extinguishing Medium (10 Hrs.)
Classification and property of foam, gases and dry chemical powder.

Unit 3: Identification, Hydraulic Calculation and Design of foam system: (12Hrs.)
Installation identification, Hazard classification, Type of protection, Hazard description, Flammable or combustible liquids area to be protected, Flammable or combustible liquids identification, foam application method, Description, number and placement of foam application devices, Selection of foam agent, Rate of application of foam solution, Rate of foam concentrate, Rate of water application, Duration of discharge, Quantity of foam and water required.

Unit 4: Identification and Design of clean agent based system: (12 Hrs.)
Determine the design concentration, Determine the total agent quantity, Establish the maximum discharge time, Selection of piping material and thickness consistent with pressure rating requirement, Piping design network and selection of nozzle to deliver required concentration at required discharge time to ensure mixing, Evaluation of compartment over / under pressurization and provide venting if required

Unit 5: Design of dry and wet chemical extinguishing agent based system: (12 Hrs.)
Physical property, Extinguishing properties, Method of application, System design, Storage of chemical and expellant, System actuation, distribution system, Quantity and rate of application, Limitations of the system, cost analysis of the system, Inspection, testing and maintenance procedure.

Learning Recourses:
Books:

Sr No	Author	Title	Publisher
1	John E. Bryan	Fire Detection and Suppression Systems	Prentice Hall PTR
2	A. Maurice Jones	Fire Protection Systems	Jones & Bartlett Learning

3	National Fire Protection Association (NFPA)	Low Expansion Foam, National Fire Protection Association, Volume 11	NFPA
4	NFPA	Carbon dioxide Extinguishing Systems, NPFA volume 12	NFPA
5	NFPA	Dry Chemical Extinguishing Systems, National Fire Protection Association, Volume 17	NFPA
7	G. C. Mishra	Concepts and Calculations, Fire Service Hydraulics.	Technip Books. International

Online Courses and Tutorials:

- National Fire Protection Association (NFPA) offers online courses on fire detection and suppression systems.
- YouTube tutorials and videos on fire alarm systems, foam systems, clean agent systems, and chemical extinguishing systems.

Codes and Standards:

- National Fire Alarm and Signalling Code (NFPA 72): Provides guidelines for the installation and testing of fire alarm systems.
- NFPA 2001: Standard on Clean Agent Fire Extinguishing Systems.
- NFPA 11: Standard for Low-Expansion Foam and Combined Agent Systems.

Subject Title: Fire Services Hydraulics

PEC3	BTSFPE603A	Fire Services Hydraulics	3-0-0	Credit 3

Teaching Scheme:	**Examination Scheme:**
Lecture: 3 Hrs./week	Continuous Assessment: 20 Marks Mid Semester Exam: 20 Marks End Semester Exam: 60 Marks (Duration 03 hrs.)

Course Outcomes: After learning the course, the students should be able to

CO 1	Able to use appropriate hydraulic systems in fire fighting devices.
CO 2	Apply basic principle of hydraulics in fire service.
CO 3	Use relationship of Hydraulic Force, Pressure, Power, and Torque with Efficiency of machines.
CO 4	Calculate the capacity of Pumps.
CO 5	Analyze the head or pressure losses in pipe flow system.

Mapping of Course outcomes with program outcomes

Course Outcomes	Program Outcomes									
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO10
CO 1	2				1		1			2
CO 2	2	2				1				
CO 3	2	1	2	3		1	1			2
CO 4	2	1	2	3		1	1		1	2
CO 5	2	2	3	2	1				2	2

All units carry 12 Marks each for End Semester Examination.

COURSE CONTENTS:

Unit 1: Introduction to Hydrants **(08 Hrs.)**

1.1 Water Supply Analysis Overview – History, Consumption, Water Source, Treatment Process, Water Distribution System, Fire Hydrants system, Storage Tanks.
1.2 Basic Principles of Hydraulics – Pascal's Law and its application in machines, Hydraulic press, accumulator, intensifier, Hydraulic ram, lift, crane.

Unit 2: Flow through Pipes **(08 Hrs.)**

2.1 Pressure Loss in pipes and Fittings, Hazen-Williams Formula, Moody chart. Flow through compound pipes, Equivalent pipes, flow through parallel pipes, flow through branched pipes, pipe networks. Power Transmission through Pipeline: Condition for maximum power transmission through a given pipeline.
2.2 Nozzle – Flow through nozzles, power transmitted through nozzle, condition for maximum transmission, nozzle reaction, relation between nozzle and pipe diameter

Unit 3: Impact of Jet & Turbines **(08 Hrs.)**
3.1 Mass Momentum equation, Impact of Jet- Force exerted by jet on stationary flat plate, moving plate, hinged plate and curved plate.
3.2 Hydraulic Machines –Turbine, Pelton wheel, Francis turbine and Axial flow Reaction turbine (Kaplan turbines).

Unit 4: Reciprocating Pump **(08 Hrs.)**

4.1 Positive Displacement Pump, Reciprocating Pumps – Introduction, main parts of a reciprocating pump, working of a reciprocating pump, slip of reciprocating pump, Variation of velocity and acceleration in suction and delivery pipes due to acceleration of piston, effect of velocity on friction in suction and delivery pipe.
4.2 Introduction of air vessels, reciprocating & ejector primer.

Unit 5: Centrifugal Pumps **(08 Hrs.)**

5.1 Centrifugal Pumps – Introduction, main parts of centrifugal pumps, Velocity Diagram, work done by centrifugal pumps(or by Impeller on water, minimum speed for starting a centrifugal pump, multistage centrifugal pumps, priming of a centrifugal pump, model testing, cavitations, suction lift, net positive suction head(NPSH), capacity calculation, maintenance of pump.

Learning Recourses:

Books:

Sr No	Author	Title	Publisher
1	K. Subramanya	Hydraulic Machines	Mc Graw Hill.
2	Yunus A. Cengel	Fluid Mechanics (SI Units) 3rd Edition	Mc Graw Hill.
3	R.K. Bansal	Fluid Mechanics and Hydraulics Machine 7th edition	Laxmi Publication
4	D.S. Kumar	Fluid Mechanics and Fluid Power	Kataria Publication

		Engineering 2nd edition	
5	C.P. Kothandaram & R. Rudramoorthy	Basic Fluid Mechanics	New Age Publication
6	P.N. Chatterjee	Fluid Mechanics for Engineers	Macmillan India Ltd.

Subject Title: Fire Smoke and Dynamics

PEC3	BTSFPE603B	Fire Smoke and Dynamics	3-0-0	Credit 3

Teaching Scheme:	**Examination Scheme:**
Lecture: 3 Hrs./week	Continuous Assessment: 20 Marks Mid Semester Exam: 20 Marks End Semester Exam: 60 Marks (Duration 03 hrs.)

Course Outcomes: After learning the course, the students should be able to

CO 1	Understand the chemistry of combustion and how fuels burn in fires.
CO 2	Explain the different ways heat is transferred and how it affects fire behavior.
CO 3	Identify the limits of flammability and the characteristics of premixed flames.
CO 4	Analyze the behavior of flames in diffusion and jet flames, and their practical applications.
CO 5	Evaluate ignition processes and the spread of flames, both in open fuel beds and within confined spaces.

Mapping of Course outcomes with program outcomes

Course Outcomes	Program Outcomes									
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO10
CO 1	2				1		1			2
CO 2	2	2				1				
CO 3	2	1	2	3		1	1			2
CO 4	2	1	2	3		1	1		1	2
CO 5	2	2	3	2	1				2	2

All units carry 12 Marks each for End Semester Examination.

Course Content:

Unit: I (08 Hrs.)

Fire Science and Combustion:

Fuels and the combustion process, the physical chemistry of combustion in fire.

Heat Transfer and Aerodynamics:

Summary of the heat transfer equations, Conduction, Convection, and Radiation.

Unit: II (08 Hrs.)

Limits of Flammability and Premixed Flames: Limits of Flammability, The structure of a premixed flame, Heat losses from premixed flames,Measurement of burning velocities, Variation of burning velocity with experimental parameters.

Unit: III (7 Hrs.)

Diffusion Flames and Fire Plumes: Laminar jet flames, Turbulent jet flames, Flames from natural fires, Some practical applications. Steady Burning of Liquid and Solid Fuels: Burning of liquids, Burning of solids.

Unit: IV (10 Hrs.)

Ignition: The Initiation of Flaming Combustion: Ignition of flammable vapour/air mixtures, Ignition of liquids, Pilot ignition of solids, Spontaneous ignition of combustible solids, Surface ignition, Extinction of flame.

Spread of Flame: The phenomenology of flame spread, Theoretical models of flame spread, Spread of flame through open fuel beds, Applications. Spontaneous Ignition within Solids and Smouldering Combustion:Spontaneous ignition in bulk solids, Smouldering combustion, Glowing combustion.

Unit: V (08 Hrs.)

The Pre-Flashover Compartment Fire The growth period and the definition of flashover, Growth to flashover. The Post-Flashover Compartment Fire: Regimes of burning, Fully-developed fire behaviour, Temperatures achieved in full-developed fire, Fire resistance and fire severity, Methods of calculating fire resistance, Projection of flames from burning compartments, spread of fire from a compartment.

Reference Books:

1. NFPA Hand Book
2. An Introduction to Fire Dynamics written by Dougal Drysdale
3. SFPE Hand Book for Fire Protection Engineering, NFPA
4. Smoke Movement in buildings by J.H. McGuire “Fire Tech.3 (1967)
5. NFPA 204M, Guide for Smoke & Heat Venting
6. Rates of Production of Hot Gases in Roof Venting Experiments by P.L. Hinkley

Subject Title: Passive Measures for Fire Safety

PEC3	BTSFPE603C	Passive Measures for Fire Safety	3-0-0	Credit 3

Teaching Scheme:	**Examination Scheme:**
Lecture: 3 Hrs./week	Continuous Assessment: 20 Marks Mid Semester Exam: 20 Marks End Semester Exam: 60 Marks (Duration 03 hrs.)

Course Outcomes: After learning the course, the students should be able to

CO 1	Understand building fire safety terminology and its practical application.
CO 2	Learn how to plan and design buildings with fire safety in mind.
CO 3	Identify factors that affect escape routes and structural fire safety.
CO 4	Evaluate the importance of fire-resistant features in buildings, like smoke extraction systems and fire-rated materials.
CO 5	Apply passive design principles to ensure effective fire safety in buildings.

Mapping of Course outcomes with program outcomes

Course Outcomes	Program Outcomes									
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO10
CO 1	3				1		1			2
CO 2	3					1				
CO 3	2		2			1	1			2
CO 4	2		2			1	1		1	2
CO 5	2	2	3	2	1				2	2

All units carry 12 Marks each for End Semester Examination.

Course Content

Unit I (8 Hrs.)

Terminology used in Buildings and different occupancies.

Unit II (10 Hrs.)

Planning & Design:-

Occupancies, General requirement in the building, Types of construction, Fire resistance ratings of materials.

Unit III (6 Hrs.)
Affecting factors of Means of Escape and Structural Fire Safety.

Unit IV (10 Hrs.)
Compartmentation, Smoke Extraction systems, Fire rated smoke extraction duct, Cable ducts and vertical and horizontal opening, steel protection and steel staircase Enclosure, Fire Escape Enclosure, Glazing, Fire load and rating, Fire separation wall.

Unit V (10 Hrs.)
Passive design and calculation based on determine size of fire and Smoke Dynamics, Implementation.

Books Recommended:

1. Life Safety code Handbook, USA
2. NFPA Code
3. SFPE
4. Fire Chief Handbook
5. Means of Escape from Fire (M. J. Billington, Anthony Ferguson and A. G. Copping)

Engineering

Subject Title: Hazards Identification and Risk Assessment

PEC4	BTSFPE604A	Hazards Identification and Risk Assessment	3-0-0	Credit 3

Teaching Scheme:	**Examination Scheme:**
Lecture: 3 Hrs./week	Continuous Assessment: 20 Marks Mid Semester Exam: 20 Marks End Semester Exam: 60 Marks (Duration 03 hrs.)

Course Outcomes: After learning the course, the students should be able to

CO 1	Attain the ability to use the hazard indices, HAZOP, PHA and What if analysis for the identification of hazards in a process
CO 2	Attain the ability to assess probability of occurrence of an event using tree and event tree analysis
CO 3	Estimate the consequences of fire, explosion and toxic gas release using suitable empirical models
CO 4	Quantity the risk involved in a process

Mapping of Course outcomes with program outcomes

Course Outcomes	Program Outcomes									
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO10
CO 1		2	3	1		3				1
CO 2	3	2		2	3					
CO 3		2	2	2	2					1
CO 4		2	3	1	2					

All units carry 12 Marks each for End Semester Examination.

COURSE CONTENTS:

Unit 1: Hazard and Risk (12 Hrs.)

Hazard and risk, Types of hazards- fire explosion and toxic gas release, structure of hazard identification and risk assessment.

Identification of hazard: inventory analysis, fire and explosion, hazard rating of Process Plant the Dow fire and explosion hazard index, the Mond index, plant layout and unit hazard rating,

preliminary hazard analysis, hazard and operability study (HAZOP), what if analysis, case studies

Unit 2: Plant Availability (08 Hrs.)

Ways of improving plant availability, MTBF and MTTF, the reliability function, failure rate, bathtub curve, probability, relationships, simple reliability estimation.Estimation of frequency of occurrence of a hazard: The logic tree approach, set theory andBoolean algebra, application to probability, Boolean manipulation

Unit 3: Process Reliability (08 Hrs.)

Fault tree analysis- logic symbols, minimal cut set, logic gates, fault tree quantification
Event tree analysis- notation, event tree construction, advantages and disadvantages of ETA
Failure mode and Effect Analysis (FMEA)- methodology, criticality analysis, corrective action and follow-up

Unit 4: Consequence Modelling (12 Hrs.)

Source Models- discharge rate models, flash and evaporation, dispersion models, Explosions and Fires- vapor cloud explosions, flash fires, physical explosions, BLEVE and fire ball, confined explosions, pool fires, jet fires.
Effect models- dose-response functions, probit functions, toxic gas effects, thermal effect, and explosion effects- Software application for effect and damage calculations.

Unit 5: Quantification of Risk (10 Hrs.)

QRA , Vulnerability analysis, accepted and imposed risk, perception of risk, risk indices and societal risk, acceptance criteria for risk ALARP, presentation of measures of risk – risk contour, F-N Curve, calculation of individuals risk and societal risk
Human reliability analysis (HRA): factors leading to human error, characteristics of HRA, Technique for Human Error Rate Prediction (THERP), Accident sequence Evaluation Program (ASEP), Techniques using expert judgment, Operator Action tree (OAT)

Learning Recourses:

Books:

Sr No	Author	Title	Publisher
1	Ian Sutton	Process Risk and Reliability Management	Laxmi Publications (P) Ltd.
2	CCPS	Introduction to Process Safety for Undergraduates and Engineers	Center for Chemical Process Safety
3	L.S.S. Reddy	Reliability Engineering	New Age International.

Subject Title: Advanced Safety Engineering and Management

PEC4	BTSFPE604B	Advanced Safety Engineering and Management	3-0-0	Credit 3

Teaching Scheme:	**Examination Scheme:**
Lecture: 3 Hrs./week	Continuous Assessment: 20 Marks Mid Semester Exam: 20 Marks End Semester Exam: 60 Marks (Duration 03 hrs.)

Course Outcomes: After learning the course, the students should be able to

CO 1	Analyze domino effects and conduct MORT analysis
CO 2	Analyze the layer of protection required for process industries
CO 3	Gain knowledge on essential elements of plant security
CO 4	Understand the concept of behavior based safety

Mapping of Course outcomes with program outcomes

Course Outcomes	Program Outcomes									
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO10
CO 1		2	3	1		3				
CO 2	3	2		2	3					
CO 3		2	2	2	2					
CO 4		2	3	1	2					

All units carry 12 Marks each for End Semester Examination.

Unit I (12 Hrs)

Domino incident investigation technique, logic diagram, input requirements, output, example. Unavailability analysis of protective systems - technique, logic diagram, input requirements, example. Reliability analysis of automatic control systems - PES safety system development logic diagram system analysis, Introduction to MORT analysis, Sneak analysis.

Unit II (12 Hrs)

Layer of Protection Analysis (LOPA) - Overview of relevant standards and guidelines, risk tolerance criteria. Preparation of LOPA - LOPA methodology, the LOPA team. Scenario development components, inherently safe considerations. Initiating causes / effects identification, estimation of frequencies. Independent protection layers - IPL criteria, allocation of IPL credit basic

Unit III (12 Hrs)

Security for chemical process industries Assessments and regulatory environment, methods for assessing security vulnerability, emerging security regulations, government development and industry activities that relate to security for process facilities. Strategies and counter measures - prevention of intentional releases and theft of chemical releases at process facilities

Unit IV (08 Hrs)

Behaviour- Based Safety (BBS) - Fundamentals of BBS Management people based safety, BBS experience, Outocmes of BBS work, psychology of BBS, Implementation problems in BBS, Behaviorual safety Observation Process. Mangers role in developing BBS culture. BBS steering committee. Main steps of True BBS approach.

Unit V (04 Hrs)

Safety Management Systems: SHEMS, OHSAS 18001 and OSHA's PSM - Policy, planning, training, implementation, management control and review.

Books /References:

1. Centre for Chemical Process Safety, AIChE : Guidelines for Chemical Process Quantitative Risk Analysis, second edition, 2000.

2. ACC: Site Security Guidelines for the U.S Chemical Industry, American Chemistry Council, Washington DC, 2001.

3. Thomas R. Krause. (1996). The Behaviour - based safety process: Managing involvement for an injury-Free Culture. (second edition). John Wiley & Sons.

Subject Title: Fire & Arson Investigation

PEC4	BTSFPE604C	Fire & Arson Investigation	3-0-0	Credit 3

Teaching Scheme:	**Examination Scheme:**
Lecture: 3 Hrs./week	Continuous Assessment: 20 Marks Mid Semester Exam: 20 Marks End Semester Exam: 60 Marks (Duration 03 hrs.)

Course Outcomes: After learning the course, the students should be able to

CO 1	Understand the behavior of fire and different types of combustion.
CO 2	Identify various fuels and potential sources of ignition.
CO 3	Learn how to investigate structure fires and collect evidence.
CO 4	Recognize different types of fires, such as grass and wild fires, automobile fires, and electrical fires
CO 5	Understand the role of laboratory services in fire investigation, including identifying accelerants and other evidence.

Mapping of Course outcomes with program outcomes

Course Outcomes	Program Outcomes									
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO10
CO 1	3		3			3				
CO 2	3			3						1
CO 3	3		2	3						
CO 4			3	3						
CO 5	3									1

All units carry 12 Marks each for End Semester Examination.

Unit: I (08 Hrs.)

The nature and behavior of fire: Elements of Combustion, Flaming and Glowing Fire, Explosive Combustion, Heat Transfer, Sequence of Room Fire, Effects of Environmental Conditions, Combustion Properties of Liquid & Gaseous Fuels.

Unit: II (08 Hrs.)

Combustion Properties of Solid Fuels: Pyrolysis, Papers, Plastics, Paints, Metals, Coals, Flame Color & Smoke production. Source of Ignition: Primary Igniter, the role of services and appliances in starting fire (Gas lines, Gas Appliances, L.P. Gas, Electricity). The role of hot & burning fragments in kindling fire, lightening, spontaneous combustion, electric light bulb.

Unit: III (08 Hrs.)

Structure fire & their investigation: Elements of building construction, General principals of fire behavior, Investigative information during suppression, Examination of structure fire scene, documenting the fire scene.

Unit: IV (08 Hrs.)

Grass and Wild Fires, Automobile Motor Vehicle and Ship Fires. Electrical causes of Fire: Basic Electricity, Wiring systems, Ignition by Electrical Means. Investigation of Electrical-related fire: Post – Fire Indicator, Laboratory Examination. Clothing & Fabric Fire, Explosion & Explosive Combustion, Chemical Fire & Hazardous Material.

Unit: V (08 Hrs.)

Laboratory Services: Availability of Laboratory Services: General Fire Evidence, Identification of Charred or Burned Materials & Documents, Failure Analysis-Forensic Engineers, Evaluation of Appliances & Wiring, Miscellaneous Laboratory Test. Identification of Volatile Accelerants: Gas Chromatography, Sample Handling, Extraction of Volatile Accelerants, Identification of Volatiles. Chemical Incendiaries Non-Fire-Related Criminal Evidence: Fingerprints, Blood, Impression Evidence, Trace Evidence.

Reference Books:

1. NFPA Hand book
2. Kirk’s Fire Investigation by Jhon D. DeHaan
3. Arson Investigation by Thomas J. Bouquard
4. Fire & Arson Investigation by Russell K. Chandler

Subject Title: Electronics & Sensors

OEC2	BTSFOE605A	Electronics & Sensors	3-0-0	Credit 3

Teaching Scheme:	**Examination Scheme:**
Lecture: 3 Hrs./week	Continuous Assessment: 20 Marks Mid Semester Exam: 20 Marks End Semester Exam: 60 Marks (Duration 03 hrs.)

Course Outcomes: After learning the course, the students should be able to

CO 1	Choose proper sensor by analyzing Principle, Classification and Characterization.
CO 2	To use and design various devices by using Electromechanical, Thermal, Magnetic, radiation and Electro analytic sensors
CO 3	Use smart sensors for safety.
CO 4	Design a system with sensors
CO 5	Able to use sensors in different applications

Mapping of Course outcomes with program outcomes

Course Outcomes	Program Outcomes									
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO10
CO 1	2					2				
CO 2	2							2		
CO 3	2			2		3				2
CO 4	2		2	2						
CO 5	2	1	2							

All units carry 12 Marks each for End Semester Examination.

COURSE CONTENTS:

Unit 1: Sensors & Transducer (08 Hrs.)

1.1 Sensors/Transducers: Principles, Classification, Parameters
1.2 Electromechanical Sensors: Introduction, Resistive Potentiometer, StrainGauge.
1.3 Capacitive Sensors: Electrostatic Transducer, Force/Stress Sensors Using Quartz Resonators, Ultrasonic Sensors

Unit 2: Thermal Sensor (08 Hrs.)

2.1 Thermal Sensors: Introduction, Gas thermometric Sensors, Acoustic Temperature Sensor, Helium Low Temperature Thermometer, Nuclear Thermometer, Magnetic Thermometer, Resistance Change Type Thermometric Sensors, Thermo emf Sensors, Thermal Radiation Sensors, Heat Flux Sensors.

Unit 3: Magnetic Sensors (08 Hrs.)

3.1 Magnetic sensors: Introduction, Magneto-resistive Sensors, Anisotropic Magneto resistive Sensing, Hall Effect and Sensors, Inductance and Eddy Current Sensors, Angular/Rotary Movement Transducers.

Unit 4: Radiation Sensors (08 Hrs.)

4.1 Radiation Sensors: Introduction, Basic Characteristics, Types of Photo resistors/Photo detectors, Xray and Nuclear Radiation Sensors,
4.2 Fiber Optic Sensors Electro analytical Sensors: The Electrochemical cell, Sensor Electrodes, Electro ceramics in Gas Media.

Unit 5: Smart Sensors (08 Hrs.)

5.1 Smart Sensors: Introduction, Primary Sensors, Excitation, Amplification, Filters, Converters, Compensation.
5.2 Information Coding/Processing- Data Communication, Standards for Smart Sensor Interface.

Learning Recourses:

Books:

Sr No	Author	Title	Publisher
1	D. Patranabis	Sensors and Actuators	PHIL earning Private Limited
2	Terokarvinen	Make sensors	Maker Media
3	Sabrie soloman	Sensors hand book	Maker Media
4	D. Patranabis	Sensors and Transducers	PHIL earning Private Limited.

Title: Transportation System and Safety

OEC2	BTSFOE605C	Transportation System and safety	3-0-0	Credit 3

Teaching Scheme:	Examination Scheme:
Lecture: 3 Hrs./week	Continuous Assessment: 20 Marks Mid Semester Exam: 20 Marks End Semester Exam: 60 Marks (Duration 03 hrs.)

Course Outcomes: After learning the course, the students should be able to

CO 1	Understand railway design, operations, safety, and analyze rapid transit systems.
CO 2	Apply highway design principles and geometric concepts for safe and efficient roadways.
CO 3	Analyze traffic characteristics, implement traffic management strategies, and promote road safety.
CO 4	Comprehend port layout, accessibility, and facilities, and evaluate their significance in water transportation

Mapping of Course outcomes with program outcomes

Course Outcomes	Program Outcomes									
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO10
CO 1	3	1		2						1
CO 2	3									1
CO 3	3		2							1

CO 4	3									

All units carry 12 Marks each for End Semester Examination.

Unit I (08 Hrs)
Introduction to importance of transportation safety, The causes of transportation accidents, The prevention of transportation accidents, The management of transportation safety

Unit I (10 Hrs)
Railway Engineering: Permanent way. Curves, super-elevation, negative super-elevation, transition curve, grade compensation on curves. Railway operation & control points and crossings, turn-out. Signalling and interlocking. Centralized traffic control. Railway accidents & safety. Rapid transit railways - types, merits & demerits.

Unit III (10 Hrs)
Highway Engineering: Classification of highways and urban road patterns. Typical cross section of roads. Factors controlling the alignment of roads. Basic geometric design - stopping and overtaking sight distances.

Unit IV (10 Hrs)
Traffic Engineering: Traffic characteristics. Various traffic studies and their applications. Traffic signals. Carriage-way markings. Traffic islands. Highway intersections. Principles of highway lighting. Road Accidents prevention, investigation and reduction.

Unit V (10 Hrs)
Harbour & Dock Engineering: Water transportation, classification of harbours, accessibility and size, ports, Indian ports. Layout of ports, breakwater, facilities (in brief) for docking, repair, approach, loading and unloading, storing and guiding.

Books/ References:

1. Rangwala, S. C. (2012). Railway Engineering. Charotar Book Distributors, Anand.
2. Chandra, S. & Agarwal, M. M. (2007). Railway Engineering. Oxford University Press, New Delhi.
3. Khanna, S. K. and Justo, C. E. G. (2001). Highway Engineering (9th ed). Nem Chand & Brothers, New Delhi.
4. Kadiyali, L. R. (2004). Traffic Engineering and Transport Planning. Khanna Publishers, New Delhi.
5. Srinivasan, R. (2013). Harbour, Dock and Tunnel Engineering. Charotar Publishing House Pvt. Ltd, Anand.

Subject Title: Chemical & Process Safety Management Lab

PCC17	BTSFCL606	Chemical & Process Safety Management Lab	0-0-2	Credit 1

Teaching Scheme:	**Examination Scheme:**
Practical: 2 Hrs./week	Continuous Assessment: 60 Marks End Semester Exam: 40 Marks

List of Practical's/Experiments/Assignments (any 8 experiments from the list)

1. To Study and demonstration of firefighting equipment.
2. To Fire Fighting with CO2 extinguisher.
3. Refilling different types of extinguishers.
4. Process safety information.
5. To study the Function & Working of Fire extinguisher.
6. To study the different types of Fire extinguisher.
7. To study different operations in chemical processes.
8. To study different types of corrosion & its control Measures.
9. To study Safety in the storage & handling of chemicals.
10. To study Process hazard analysis.
11. Principles safety management System.

Subject Title: Fire Detection and Installation Fire Fighting System-I Lab

PCC18	BTSFCL607	Fire Detection and Installation Fire Fighting System-I Lab	0-0-4	Credit 2

Teaching Scheme:	**Examination Scheme:**
Practical: 4 Hrs./week	Continuous Assessment: 60 Marks End Semester Exam: 40 Marks

List of Practical's/Experiments/Assignments (any 10 experiments from the list)

1. Compare different types of detection devices and their applications.
2. Calculate the cost of components for an alarm and detection system.
3. Design a layout for an effective alarm and detection system.
4. Discuss the properties and classifications of foam, gases, and dry chemical powders.
5. Classify hazards and calculate foam solution quantities for specific scenarios.
6. Determine clean agent concentrations for confined spaces.
7. Design a clean agent distribution network with nozzle selection.
8. Compare dry and wet chemical extinguishing agents for effectiveness.
9. Create a flowchart for actuating a dry chemical extinguishing system.
10. Outline inspection and maintenance procedures for chemical extinguishing systems.
11. Estimate costs of installing chemical extinguishing systems versus potential damages.
12. Investigate applicable standards for foam, gas, and dry chemical systems.

Subject Title: Competitive Skills (Audit Course)

		Competitive Skills	------	-----

Teaching Scheme	Examination scheme
Lectures: 2 hrs/ Week	

Course Outcomes: After learning the course, students should able to

CO1	Exhibit attitude and effective communication to maximize efficiency in work.
CO2	Demonstrate reasonable quantitative aptitude
CO3	Apply logic to solving the problems.
CO4	Interpret data in the field of work while performing the practical task.

Course Contents:

Unit 1: Communication and Listening skills (08 hrs)
Component of effective communication, types of communication- oral, written, reading and body language, handling of communication, barriers of communication, listening tools, nonverbal communications and its importance.

Unit 2: Personality development : (04 Hrs)
Self-management and personality development, SWOT analysis, self-learning and management, motivation ad image building technique.

Unit 3: Quantitative aptitude: (12 Hrs)
Introduction, comparing quantities viz. speed, age, height, ratio, percentage, weight and price etc. Introduction to cost price, sale price, profit, loss and discount of product.

Unit 4: Logical reasoning: (8 Hrs)
Introduction to logical reasoning, Types of logical reasoning (verbal and nonverbal), Principal of logical reasoning with examples on numbers and sequences arrangement and relations. Problems

based on Scheduling, blood relation, direction and distance, linear arrangement and circular arrangement etc.

Unit 5: Data Interpretation: (8 Hrs)

Data analysis and interpretation, types of variables for different applications, introduction to basic graph types like Bar, Pie chart, line, missing data interpretation, tabular form etc

Reference/ Text Books:

1. Communication Skills for Professionals by Nira Konar
2. Communication Skills by Sanjay Kumar
3. Quantitative Aptitude for Competitive Examinations by R S Aggarwal
4. How to Prepare for QUANTITATIVE APTITUDE for CAT by ARUN SHARMA
5. Data Analytics: Principles, Tools and Practices by Dr. GauraavAroraas
6. A Complete Book of Data Interpretation (Third English Edition) Adda247 Publications
7. Data Interpretation by K. Kundan
8. A Modern Approach to Logical Reasoning: by Dr. R S Aggarwal
9. A Complete Book of Logical Reasoning by Adda247 Publications
10. Analytical & Logical Reasoning For CAT & Other Management Entrance Tests by Peeyush Bhardwaj

Solve any ten assignments from the following.

1. Assignment based on Component of effective communication, types of communication-oral, written, reading and body language, handling of communication.
2. Assignment based on the barriers of communication, listening tools, nonverbal communications and its importance.
3. Assignment based on Self-management and personality development, SWOT analysis, self-learning and management, motivation ad image building technique.
4. Assignment based problems for Introduction, comparing quantities viz. speed, age, height, ratio, percentage, weight and price etc.
5. Problems based on cost price, sale price, profit, loss and discount of product.
6. Introduction to online internet banking mechanism, various modes of payments, cash transaction and associated mobile apps.

7. Concept of insurance and taxes and types. Introduction to unit and dimensions of different objects.
8. Introduction to logical reasoning, Types of logical reasoning (verbal and nonverbal), Principal of logical reasoning with examples on numbers and sequences arrangement and relations.
9. Problems based on Scheduling, blood relation, direction and distance, linear arrangement and circular arrangement etc.
10. Introduction to logical reasoning, Types of logical reasoning (verbal and nonverbal)
11. Principal of logical reasoning with examples on numbers and sequences arrangement and relations.
12. Data analysis and interpretation, types of variables for different applications, introduction to basic graph types like Bar, Pie chart, line, missing data interpretation, tabular form etc.,

Subject Title: Drill - IV

LC3	BTSFD511	Drill – IV	0-0-4	Credit 2

Teaching Scheme:	**Examination Scheme:**
Lecture: 4 hrs./week	Continuous Assessment: 50 Marks

Practical syllabus based on Standard Drill Manual and Code & Practice.

Group A – Squad Drill

Group B – Safety Drill.

Books Recommended:

4. Fire Service Manual U. K.
5. NFPA U. S. A.
6. Drill Manual India